

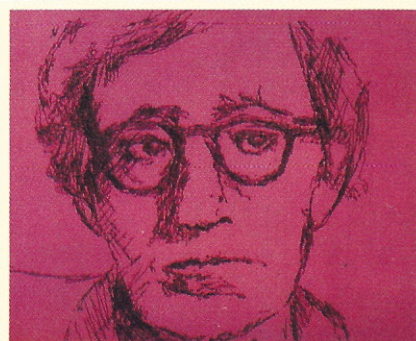
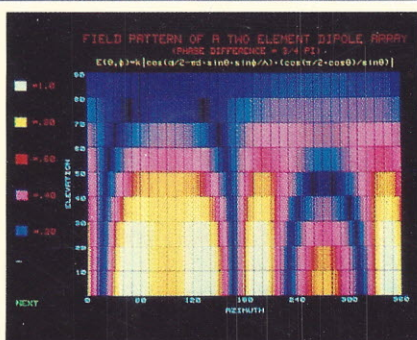
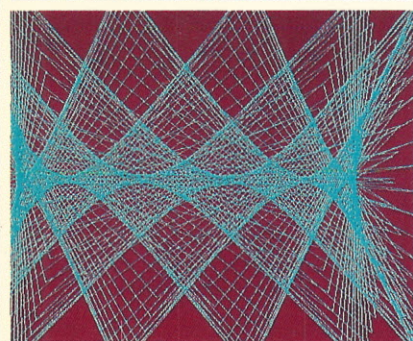
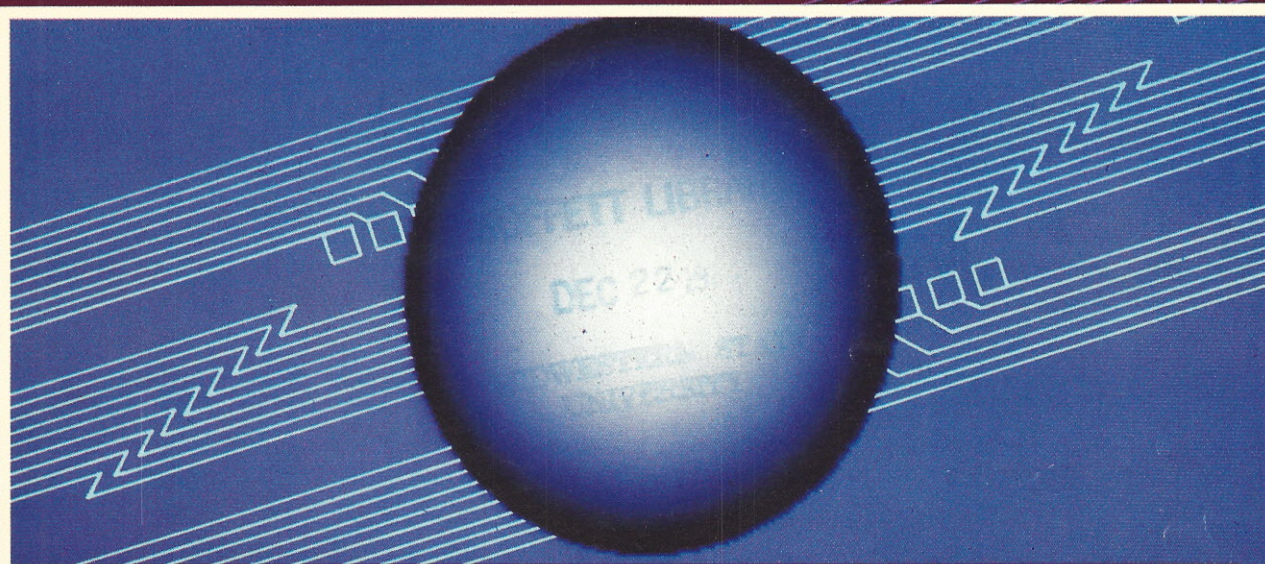
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INTERFACE AGE™

FEBRUARY 1981

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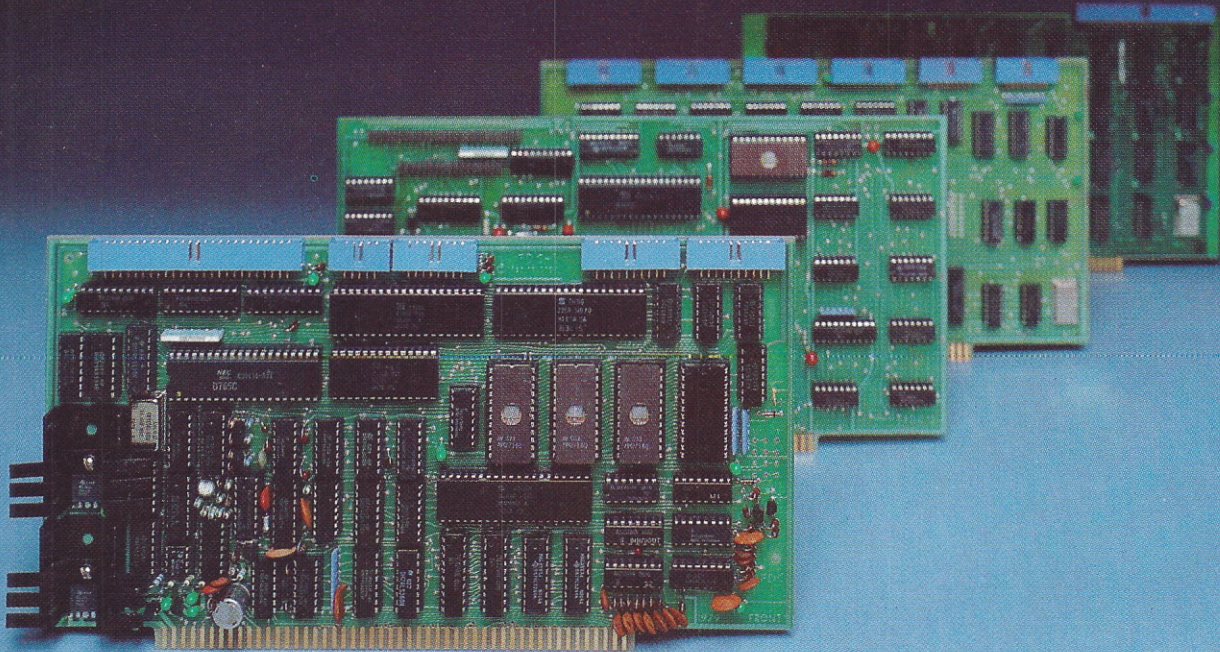
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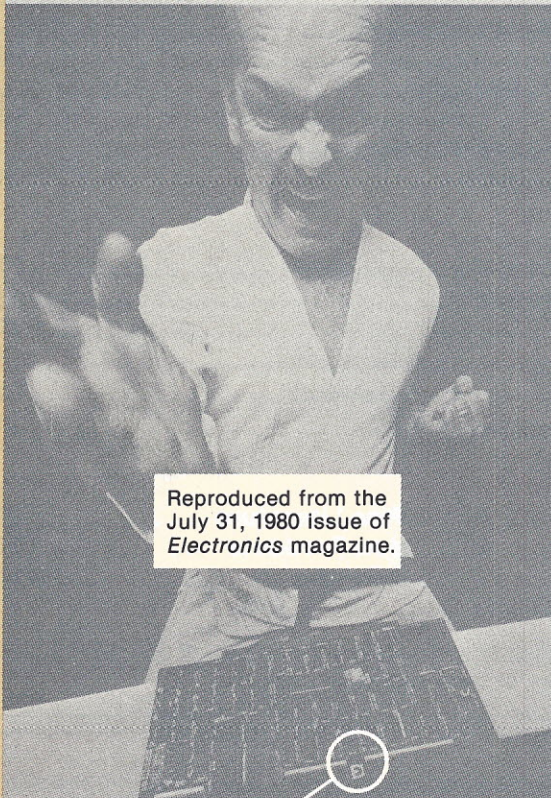
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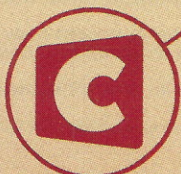
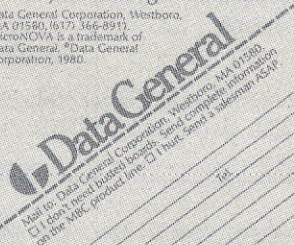
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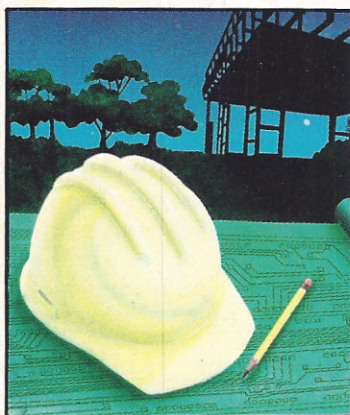
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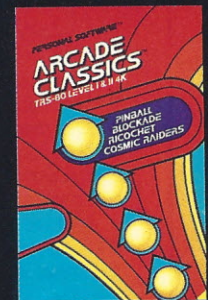
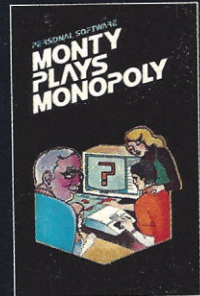
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CIRCLE INQUIRY NO. 31

Trade show heroics during MGM Vegas fire

No one who attended Comdex '80 will ever forget it, for this was the year of the tragic hotel fire in Las Vegas. Awakened on the final day of the show by the sirens of emergency vehicles, we looked out to a morning of smoke-filled gloom and—incredibly—one of the largest hotel complexes in the world burning out of control right before our eyes.

Walking to the convention center under the thundering slaps of Air Force rescue helicopters, we felt a grim gladness that this product of man's technological genius could be put to use so effectively in helping the victims. Watching the dozen Green Giants plucking wave after wave of frightened yet relieved humanity off the 28-story rooftop, it seemed as if the machines had been constructed for just such a mission.

Was there a way, we asked, that another of man's inventions—the computer—could help in this effort? At the time we thought "no," and in doing so, badly underestimated the resourcefulness of the computer community gathered on that smoky winter morning.

The first clue came but minutes later, when we were unceremoniously booted off a demonstration computer in the Prodigy booth while exploring a new general ledger package. A grim-faced programmer moved in and, with determined efficiency, began keying in a refugee correlation program. It was happening all over. With perhaps a thousand of the most advanced computers ever invented assembled in the same room with the cream of the industry's engineers and programmers, something good had to happen. And it did.

An adjoining empty hall of the convention center was transformed almost instantaneously into a "survivors center." In big yellow school buses, they arrived in sooted night clothing, dazed and empty-handed. A good portion of the 8,000 victims filled that room, being fed, clothed and comforted by the Salvation Army and other volunteers too busy to take credit for the great need they were fulfilling. We recognized several—both helpers and those in need of help—who the afternoon before were showing us their software. As if by magic, a command center grew in the center of that great hall, equipped with radio equipment, telephones, a public address system and computers.

Yes, computers. Plucked from their display pedestals in the adjoining room, stripped of their games and financial programs, Commodore PETs and others began processing a new kind of information. With data being fed from floor

interviewers and open lines to every hospital in town, lists were printed and posted, requests correlated, families reunited. As the afternoon wore on and hotel guests were led from their hotel rooms by rescue workers, news of their safety was processed instantly, available to the news media for transmittal all over the world. The computers worked flawlessly, processing the hastily drawn programs without a hitch. Like the helicopters still on their mercy flights, it seemed as if the computers had been built for just this kind of mission.

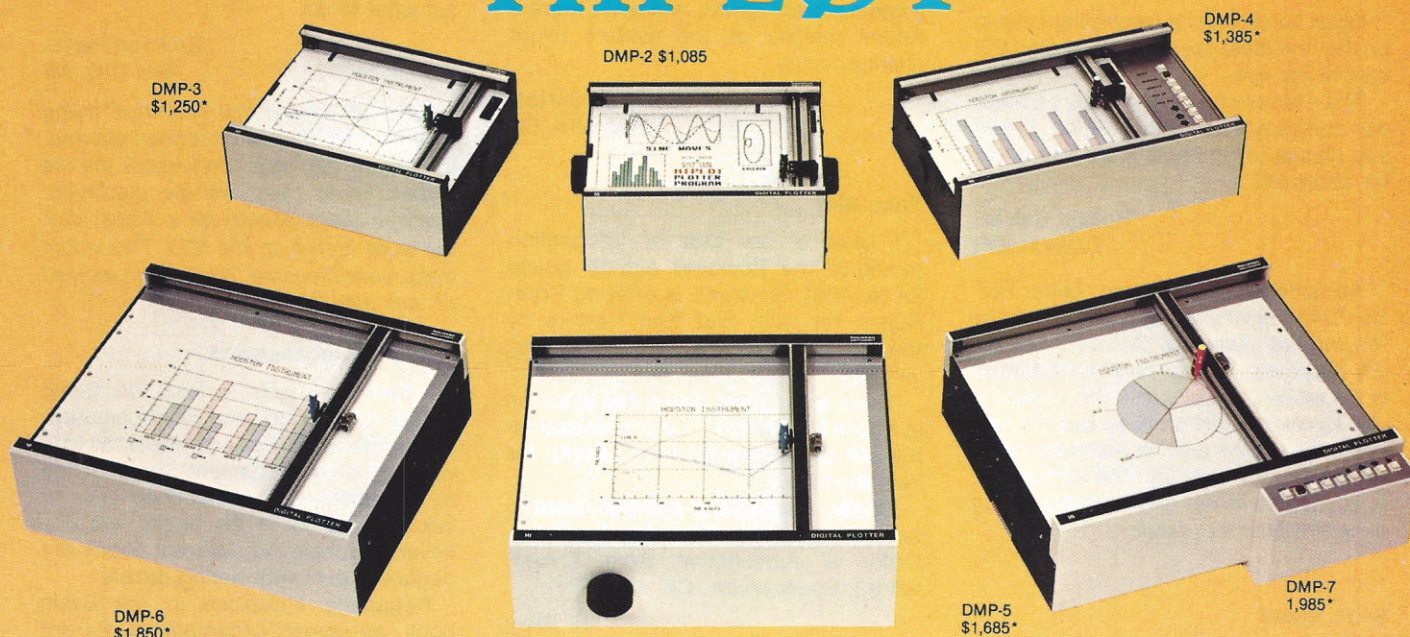
Back at the computer show, other forms of heroism surfaced. The Q1 Corp. booth was manned by a single programmer whose smoke-fragrant clothing and still-white face testified to an experience never to be forgotten. Some talked excitedly about their experiences; some, not at all. The tiny Corvus booth held four in hastily-donned casual clothing. They weren't selling or even talking; just huddled in the scant comfort of the only home remaining to them in this suddenly hostile city. It could have been worse...much worse. The previous year's Comdex was held, in its entirety, within the now burned-out hulk of the MGM.

The show itself—Comdex '80—was for "the trade" only. Owners of computer stores were invited, as were systems houses and other original equipment manufacturers. Exhibiting were some 300 manufacturers of computers and computer-related products. We saw many new products destined for introduction during the rest of 1981; products we'll be telling you about in this and future issues. Among them is the Hewlett-Packard HP-85 microcomputer with Visicalc Plus, that successful financial program with a new twist: automatic output of multi-colored bar charts and pie charts on an accessory flat-bed plotter. It's a hint of the many ways sophisticated computer graphics are creeping into business computing.

We saw evidence of a quiet, behind-the-scenes revolution taking place in the merchandising of personal and small business computer products. The new phenomenon—local distributors who act as buffers between computer manufacturers and retail outlets—is actually an old and familiar way of doing business just beginning to find its way into this industry. Next month, we will explore what these changes mean to the ultimate purchaser. We will also take a look at some alternate sources for computer products; new ways you can put the power of a computer into your office, factory or home.

T.F.

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Taxing question

Elliott MacLennan's fascinating column on the "greatest tax shelter" (IA Dec 80) caught my eye.

The example he gave closely parallels our company's current situation. Could you please tell me how more info could be obtained?

Roland Belveal
Tualatin, OR

According to MacLennan, *Letter Ruling 7843009 of July 25, 1978 issued by the Internal Revenue Service specifically approves the transaction described in the article. The situation this company was involved in can probably be improved upon by a plan loan in accordance to ERISA Section 408 (b). The transaction in question was not only possible but an excellent business tactic.*

BIOS bias?

I protest a programming technique recommended in "CP/M for the TRS-80 Model II" (IA Nov 80). Alan Miller says "If you want to write a system monitor in assembly language that performs direct console input and output, it might be easiest to use the CP/M BIOS routines." This is *never* easier, in fact never better in any way.

First, the code to call BIOS is usually longer. Had they used simple, standard calls on the normal system monitor, the routines given in the article would have been several bytes shorter, easier to read and understand. Both advantages would be purchased at the price of a trivial amount of overhead due to processing in CP/M—insignificant since the program's speed at this point is conditioned by the speed of the terminal and the user's fingers.

Second, calls to the BIOS miss the checks that CP/M makes for control characters. If output goes directly to BIOS, then the user cannot cause the program's output to pause by keying control-S, nor can he start or stop copying of console output on the printer with control-P. If input is gotten directly from the BIOS, the user can't abort the program with a control-C; his only recourse is to force a cold start with the reset button.

Third, and perhaps most important, is the fact that by putting calls to the BIOS in a program one makes it non-portable. The service call interface supported by CP/M can be relied upon to work in MP/M, in Cromemco's CDOS, and in any other CP/M compatible operating system. The interface to the BIOS

cannot be relied upon to work in any system except CP/M, and even there a future release of the system might change things.

David E. Cortesi
Palo Alto, CA

Take Aim

I have a few bits of information to add to the Rockwell Aim-65 article (IA Nov 80). Rockwell is offering Forth ROMs for Aim, and Eric Rehnke of the company has his own RAM-based version.

There are at least seven disk systems available for Aim-65. The printer assembly can be purchased from Olivetti for less than \$50.

Finally, there is a newsletter devoted exclusively to Aim-65 related articles. Order a subscription from Target, RR #2, Spencerville, OH 45887.

R. Riley
Flint, MI

Reverse psychology

In the article "Improving Your Console Input" (IA Oct 80), Hugh Poyner seriously maligns all programmers who choose to use CRT devices in a scrolling mode, by claiming they use the computer's power in reverse. He describes how screen based CRT output should be handled by writing a screen full of lines, waiting for a response from the viewer, and then erasing the screen and continuing as above.

I agree with the screen oriented, menu driven approach to user interfacing but it is not always appropriate. There are many instances, such as text insertion, where there is a desire to maintain a contextual view of what has already been entered. If you erase the screen rather than scroll, context is lost.

I was delighted that the article emphasized the importance of good user interfaces. Quality application software is the key to expanding the use of microcomputers in the business community and enticing the qualified consumer to apply these systems in the home as well.

Michael C. Brenner
Benton Harbor, MI

Bug catching

Need help! Can't get "Place a Special Order on Real Estate" (IA Oct 80) to run. I go all the way through 'Adding an M.L.S. Property' until I put in an answer for 'Heating Method'. It then says

'Error #6 at line 530' and I can't figure out what to do.

Bronson Harris
Bay City, MI

Error #6 means that you were trying to write a file that had not been opened. If you use the 'mon' command, the file names being used will be displayed. Perhaps there should be a blank after the word 'data4' in line 530. This would make your filename 'mls data1' instead of 'mls data 1'.

'Basic' disagreement

I feel the book reviews on Basic Primer (IA Nov 80) and Microcomputer Primer (IA Oct 80) do not reflect the true value of these beginners' texts. When my coauthor and I researched prior to our preparation of the books, we discovered people did not want overly dry pedantic texts with boring details.

Regarding omissions in the Basic book, structured programming did not seem to belong there. It is a very important, but abstract, subject to learn and de-motivates students if introduced too soon. We left out disk Basic commands because disk I/O is not standardized; the subject is too large in scope; and most people learn Basic with a tape cassette storage system, then move up to disk later.

For quite some time, the philosophy behind primer books has been simple, upbeat language, good drawings, and lots of graphics. I hope in the future your reviewers explore these aspects in more depth.

Mitchell Waite
Greenbrae, CA

Cul-de-sac

While investigating a disk of new utility software, I came across an unusually useful program that enables the user of CP/M to recover from a variety of system halts and lockups, and not lose any prior program or data from RAM.

The program is merely a file entry with a length of zero records. When you execute any .COM file, it is read into memory starting at 100H, and the CPU begins to execute at the same starting point. Thus if you have a .COM file of zero length, it reads nothing new into RAM, and begins to execute whatever was in RAM prior to the request.

With the Microsoft interpreter, this causes you to be back under interpreter control, with the program and all variables still intact. The only proviso is that you have not read in any other .COM files or powered down in the interim.

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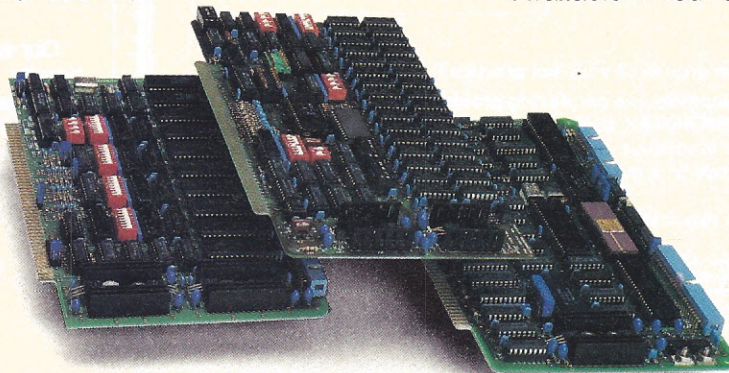
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You can even intentionally leave Basic (using the 'system' command), and use all of the intrinsic CP/M commands, like 'dir', 'era', 'type' and 'save', without hampering your ability to return to the interpreter, program and all.

The methods:

CP/M version:

SAVE 0 GO.COM

Microsoft Basic version:

OPEN "R",1,"GO.COM":CLOSE

Immediately after either of these commands, you will see in the directory a file of zero length called GO.COM. To test it, run any .COM file, push reset or CTL-C during execution, and then simply type 'go'. If you are running Basic, you will see the OK prompt, and with other

programs, you will be back executing the file, without having to read it again from disk.

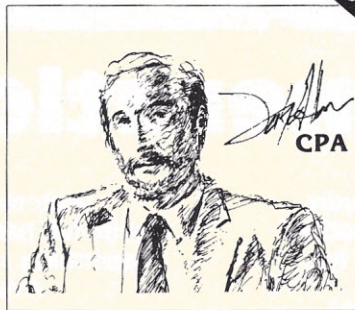
Another use is to allow repeated execution of a program without having to re-read it each time from the disk. This could be a time saver when you don't have the source code of a program, and it does not have a built in repeat function.

Neil Rosenberg
Littleton, MA

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Readers to the rescue

We have several Northstar Horizon computers with Intertube III CRTs that we use for educational purposes. We need some way for up to 50 students to view what is happening on the CRT screen as the instructor works with the computer during class. Do you know of any way this could be done?

J.B. Orris
Butler University
College of Business Administration
Indianapolis, IN 46208

Our school is planning to involve itself heavily in computer-assisted instruction, computer-managed instruction, and computing science. The hardware will consist of an Apple II Plus (48K) system with a disk drive. We would appreciate receiving any applicable information.

Tom Jones
Rosedale Jr. Secondary School
Drawer 130
Rosedale, B.C., Canada
VOX 1X0

Our industrial arts program utilizes an inventory-requisition card system that numbers over 6,000 items of supplies, materials, tools, etc. I am investigating the possibility of putting this onto a computer system. I would appreciate any information to help me get started.

Clyde Cover
Cumberland Valley School District
6746 Carlisle Pike
Mechanicsburg, PA 17005

I am interested in the study of astrology. Having a Heath H8, H14, H17 (2 drive) and H19, I would like some advice on where I can obtain astrological software.

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Cash and come-ons used to lure top talent

While there might be a tendency to think of bounty hunting as a thing of the past, it's alive and well in California, where many high technology companies are using not only cash but creativity when it comes to getting their man.

Because of the scarcity of top flight technical talent in the state, one major electronics firm is offering \$3,000 for a referral that results in a new employee. Another company gives a week's pay up-front with the bonus handed over the day the person starts. Yet another has contests with prizes ranging from baseball tickets to television sets to vacation trips.

The seeds for today's labor shortage of both engineers and managers were sown in the 1960s and cultivated in the early 1970s, according to William T. Mangum of Thomas-Mangum high technology search firm. "In 1970-71 the aerospace industry was rocked by a recession. Colleges and universities discouraged students from entering the

industry. That, combined with all the stories about alcoholism and divorce because of the downturn, created a heavy migration away from aerospace," Mangum claims.

"Consequently, today we have an experience gap. Many engineers have more than 20 years experience and many have less than 10 years, but there aren't many in the middle."

What will some of the solutions be? In addition to upfront money, more companies are paying not only relocation costs but mortgage differentials. They are helping spouses find jobs when a family move is made.

Mr. Mangum also sees other options being explored such as retired employees used as a labor pool for part-time work or on a consulting basis. He suggests the formation of "industry universities" or technical training schools that offer highly concentrated and abbreviated programs. He also believes that manpower planning should be upgraded to a senior management level, including development of advisory

committees on the board of directors similar to compensation committees. Mangum feels that the growth of industry depends on its ability to attract and hold top level high technology talent.

Consumers prefer movies to interactive programming

Features like freeze-frame, reverse, and random access make for impressive video disc demonstrations, but consumers are more interested in traditional formats. Recent and classic movies are the most highly rated program categories; programs which call on viewer participation draw only modest interest.

Statistics issued by Venture Development Corp., Wellesley, MA indicate that people owning video equipment and people not owning any rank prerecorded program categories about the same. Both groups rate participation programs like sports lessons or do-it-yourself shows among the lowest of the seventeen program categories tested.

Almost two-thirds of those surveyed express a strong interest in recent

If you have an Apple, Pet or TRS-80 microcomputer,* you can have fantasy at your fingertips with Epyx computer games from Automated Simulations.

Like me, you're probably really into games, all sorts of games. But an Epyx game is more than a game — it's an experience, and it's a chance to use your computer for something other than work. The great thing about Epyx games is that you have a choice. Whether you're a beginner or an expert, you can find games that are easy to learn. Challenging. Fun to play for twenty minutes or

**"I can rescue ten prisoners
slay a mad wizard, retrieve
stolen treasure and save
money. So
can you!"**

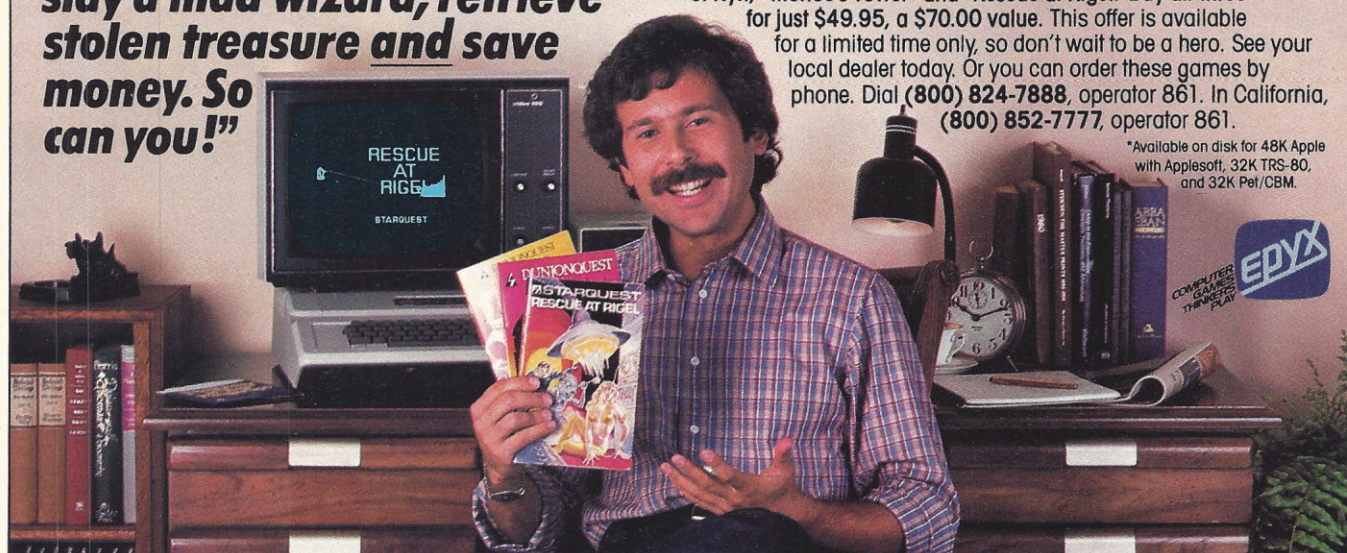
hours at a time. You can play these games over and over, because you're constantly trying new tactics and strategies.

I've already entered and re-entered a world of monsters and misfits, demons and dwarves, trials, tribulations and treasures with a game called "Temple of Apshai." Now it's my chance to have fun with three more games from Automated Simulations... and I can save money, too!

With "Dungeons of Ryn" and "Morloc's Tower," I get to escape from booby-trapped mazes, find more treasures and zap more monsters. And with "Rescue at Rigel," I get to outwit the nasty High Tollah and free 10 prisoners.

Automated Simulations has a special offer on "Dungeons of Ryn," "Morloc's Tower" and "Rescue at Rigel." Buy all three for just \$49.95, a \$70.00 value. This offer is available for a limited time only, so don't wait to be a hero. See your local dealer today. Or you can order these games by phone. Dial (800) 824-7888, operator 861. In California, (800) 852-7777, operator 861.

*Available on disk for 48K Apple with Applesoft, 32K TRS-80, and 32K Pet/CBM.





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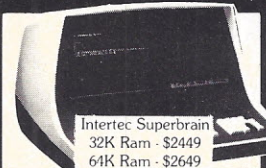


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movies and over half are very interested in movie classics. Between one fifth and one third of all consumers express strong interest in pop, rock, or jazz concerts and educational software.

Venture consultant Raymond Boggs notes, "It's reminiscent of the early days of television, when programs were identical to radio shows in structure, format, and even personalities. It took years for television to develop unique forms and the same will hold true for the video disc programming."

Computer graphics industry scores record sales

The computer graphics market will grow from \$1.4 billion in 1980 to over \$4 billion in 1985, according to a report by Strategic Business Services, Inc.

During the same period, the greatest proportion of expenditure will shift from hardware to software.

The report indicates that computer aided design will continue to maintain the lion's share of the market through 1985, despite other forecasts which indicate that business graphics will dominate. The study, which segments the CAD market into 3 major subcategories (circuit design, mechanical design, and drafting and cartography), points out several significant issues. The report documents how the use of CAD/CAM systems frequently shows a payback of less than 1 year and that users can increase output 2 to 5 times over manual methods in many applications. The obvious increase in productivity, coupled with investment tax incentives, will continue to fuel the growth of this segment of the industry.

One voice to represent all computer owners

A single trade association, the Computer Dealers and Lessors Assoc. (Milwaukee, WI), has been formed by the merger of the Computer Dealers Assoc. and the Computer Lessors Assoc. The CDLA will be the single voice to represent the interests of those companies and institutions who own computer equipment. CDLA members will have \$5 billion in equipment owned in 1980, and at least \$30 billion is owned by private and other entities, according to William S. Grinker, co-chairman.

The CDLA will have as one of its primary objectives, Grinker added, a protection of the interests of computer owners in relation to the manufacturers, software and maintenance companies, insurance firms, common carriers, governmental regulatory bodies, government taxing authorities and others.

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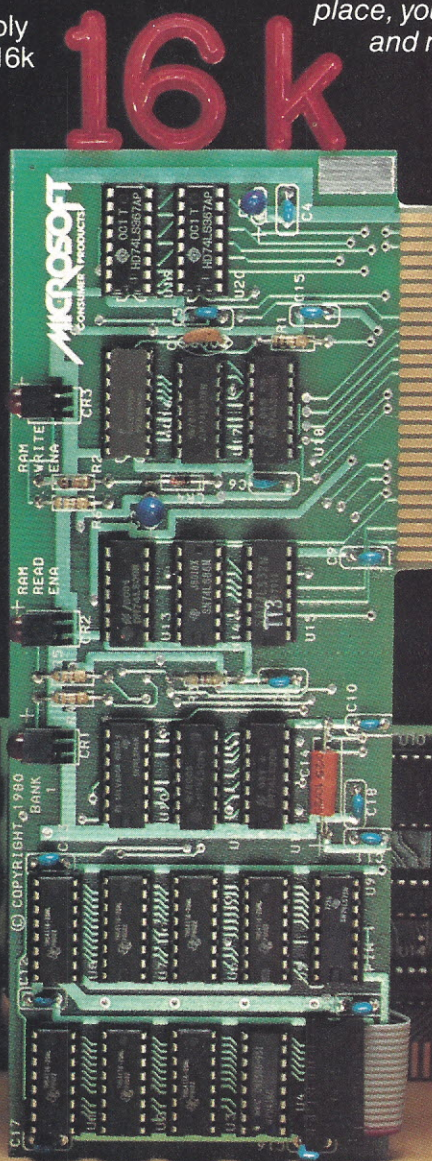
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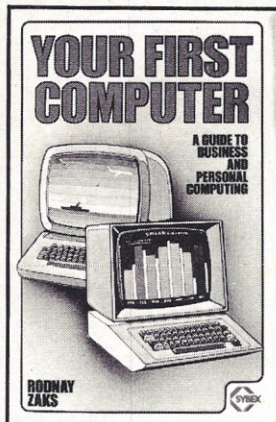
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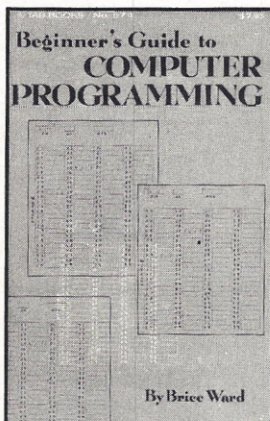
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by Bruce Ward

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A primer for learning computer programming from the ground up. Instead of attempting to explain programming in terms of language, the author pursues his subject from the viewpoint of program requirements. Instead of working backward from a language, the book begins by developing a simple programming language of its own, determines a need, then gives the instruction.



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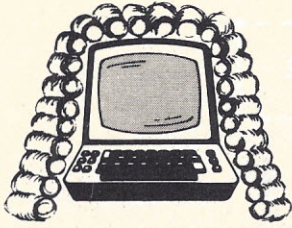
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JURISPRUDENT computerist



By Elliott MacLennan
Attorney at Law

Software Sales Tax...An Update

Software developers and users have cause to celebrate. A recent California decision legally ruled that state sales tax does not apply to a transfer from one company in the audiovisual business of master film negatives to another company because the "true object" of the property transferred was intangible.

The case, *Simplicity Pattern Co. vs. State Board of Equalization* (BOE), decided in January 1980, presents a well reasoned and decisively written legal opinion which, in addition to discussing film negatives (a close analogy to software) discusses Peter Benchley's *Jaws*, Arnold Palmer's golf tips, and the Beatles' *Yellow Submarine*. The court reasoned that film negatives were "products of the expertise of the collective mind" and therefore intangible.

To be taxable in California, the subject matter of assessed property must be tangible. Software, to this writer, falls outside the definition of tangibility.

Simplicity Pattern is now up for appeal to the California Supreme Court. Interestingly, the California Sales Tax Action Group (STAG) will file a friend of the court brief in an attempt to persuade the court to strike down or gut Regulation 1502, California's software sales tax law. STAG's proposed argument: a software consumer purchases the message not the medium. The message—instructions communicated in human or machine language—is intangible and therefore not subject to sales tax.

STAG may already have a friend in court: the majority in the appellate division have not only ruled that the property in question was intangible, but released a militant broadside against the BOE for failing to "be faithful to its own pronounced regulations."

To be intangible, an item cannot be weighable, measureable, touchable, or perceptible to the senses.

Arguing in favor of tangibility, the BOE, trying to impress the court, equated film negatives with tools and dies. This line of reasoning is not only inaccurate but archaic. The subject is intellectual property: film negatives, software, original manuscripts, sound recordings, trade secrets, secret processes—not tools, dies, molds, machinery or widgets.

The specific question the appellate court addressed was whether the "true object" of the transfer (film negative) was tangible or intangible. The answer of course is that film as celluloid is tangible, but the "true object" of *Simplicity Pattern*'s assets was the intangible literary effort "captured" on the film. Again and again, state taxing authorities confuse the contained for the container.

In this extraordinary attack against the BOE, the California Legislature has determined what is or is not tangible. BOE, as a subordinate bureaucracy, must shape its policies to conform to sovereign mandate.

In *Simplicity Pattern*, however, the court denounced BOE's alchemy: transmuting an intangible into a tangible item. The

court further noted that the BOE regulations were inconsistent in themselves: taxability of property "cannot turn on its appeal to particular literary tastes."

California software vendors would reap a tremendous cost-competitive advantage over other states, which impose sales and use tax on canned software, if the state Supreme Court upholds the appellate decision. Should *Simplicity Pattern* be overruled, off-the-shelf software would continue to be taxed.

The Massachusetts Department of Revenue, for example, is attempting to classify prewritten or canned software as "tangible" and impose a sales tax. In Massachusetts, a major industrial center, technology-oriented firms would suffer a severe economic setback. Revenue-wise, a tax collector that succeeds in taxing software is guaranteed a tax bonus simply by the proliferation of software. The war clouds are gathering; outcome unpredictable.

Private industry in Massachusetts has an advantage not found in California. Several years have passed since the adoption of California's software sales tax. Numerous states have since declared software intangible and nontaxable. This past year alone nine other states have declared software nontaxable on grounds of intangibility. The trend is clearly running against the tax collector.

Although the *Simplicity Pattern* case is not home free (there are several non-software film negative points to be overcome including a disturbing concurring opinion), I predict that California's Supreme Court will uphold the appellate decision, and thus give software vendors and users a substantially stronger position when a software case is targeted for a test in the courts.

The sales tax battles are about to mature from infancy into adolescence. Soon I believe a new battle will begin: firmware vs. sales tax.

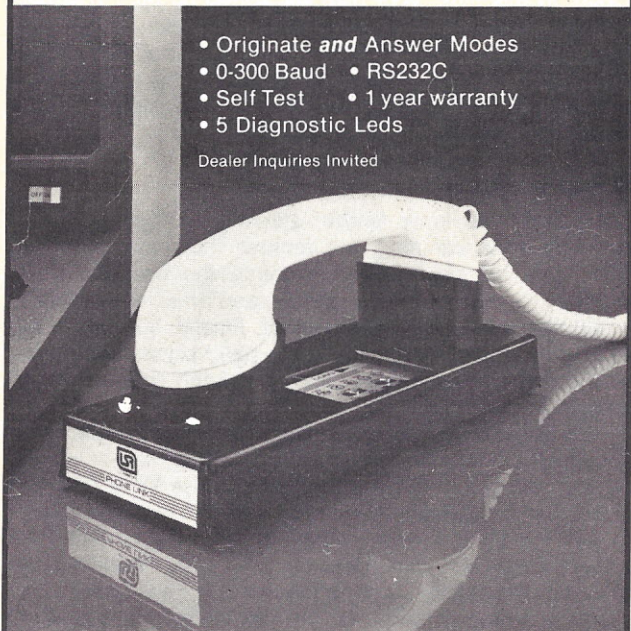
This material should be considered general information. Readers should consult professional advisors prior to applying it to specific situations. □

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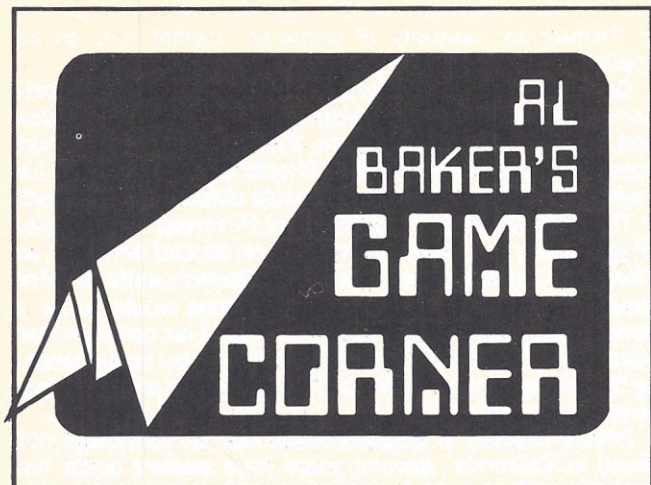


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CIRCLE INQUIRY NO. 65



Lunar Lander with "Sound"

In my April 1980 column, I presented a program on the TRS-80 that responded to the player's voice. It was called Attack Command Alpha. This month we are going to again use sound input on the TRS-80 model I. The program is a classic. Across the bottom of the screen is a line representing the surface of the moon. At the top of the screen is a falling spaceship that you try to land. Simple!

Our version of the game does not use the keyboard for input. Neither does it use joysticks, paddles, or any other manual input. As long as you make a sound like a rocket firing, the lander fires its engines. Stop making noise, and the lander's engines also rest.

In the upper right corner of the screen are your flight statistics. Your initial altitude at time zero is 4800 feet. You are falling at 50 feet-per-second and your lander contains 500 units of fuel. The screen is updated every 1/5th of a second. In this time, your ship will speed up by 1 foot-per-second in the lunar gravitational field. Your engines can burn three units of fuel every 1/5th second. A unit of fuel will decelerate your ship by 1 foot-per-second. In the lunar gravitational field, firing your engines will slow your ship by (3-1) or 2 feet-per-second each 1/5th second.

Prepare for firing

To control the lunar lander, attach your tape recorder. Insert the black ear plug, but remove the remote and aux plugs. Use the eject button to open the cassette door, reach into the cassette tape holder, and press the button at the left-rear inside the compartment. Finally, hold down the record button and press play. If you can't press record, you aren't pushing the correct button at the left rear inside the cassette compartment.

When you run the program, you will see your spaceship falling toward the moon. Start making a loud rocket sound, and your ship will start slowing down. On the TV screen you will see flames shooting out of the rear of the spaceship.

If you impact the lunar surface with a velocity less than 11 feet-per-second, your mission is a success. Hit the surface with a higher velocity, and the moon has a new crater.

Look at listing 1. Lines 60 to 130 define the important variables in the program: T=time, H=altitude, HO=old altitude, V=velocity, and F=fuel. A\$ contains a picture of a falling spaceship, B\$ contains a picture of a ship with its engines burning, and C\$ is a picture of the spaceship near the ground. These pictures are constructed using TRS-80 character graphics, where the number of the pixel turned on in the position is added to 128 to form the Ascii value of the character:

	1		2	
	4		8	+ 128
	16		32	

The spaceships are:

Falling

		2		
	4			4

Firing

		2		
	4			4
		32		

Landing

		2		
	4			4
	16	32	16	32

Lines 170 to 200 set up the TV screen and the primary game loop begins at line 250. Voice input is handled on lines 250 to 280. Your rocket engines are assumed to be idle on line 250. Line 260 sets up the input port to accept sound input and line 270 turns on the rocket thrust if sound is being received through that port. If the thrust requested is greater than the remaining fuel, line 280 corrects the thrust output. No thrust is possible if there is no fuel left.

The spaceship is erased and drawn on lines 320 to 360. The equation $\text{INT}(\text{HO}/320)$ converts the rocket's altitude into a screen line number between 0 and 15. Multiplying this by the length of a line (64) and subtracting the result from the landing location at position 980, computes the correct print location for the rocket. Which rocket picture is displayed is

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rs, nails	1,225.22	01596	1,225.22
etting	9,955.23	01583	9,955.23
	15,000.25	01616	15,000.25
	100.00	01617	100.00

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00044	02223	01770	06/10/79	3,381.00	69.00	3,450.00
TOTAL DUE AS OF 06/20/79				52,050.09		52,933.76
00134	02229	00026	06/30/79	1,500.00	0.00	1,500.00
00179	02230	00000	06/30/79	0.00	0.00	0.00
TOTAL DUE AS OF 06/30/79				53,550.09		54,433.76
00223	02233	01882	06/02/79	16,655.24	0.00	16,655.24
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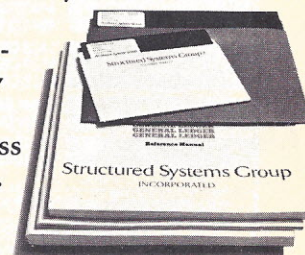
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determined on lines 340 and 360. If the altitude of the rocket is less than 320 feet, it is landing and C\$ is chosen as the correct picture.

Lines 370 to 400 print the ship's statistics on the screen. Note that T is divided by five. T is kept in fifths of a second, so it must be divided by five when printed. The new statistics are computed on lines 440 to 480. The fuel supply is decreased by the amount of thrust on line 450 and the new velocity is computed on line 480. Note that the ship tries to speed up by one each time the program loops. This is modified by subtracting the thrust, which can be three when the engines are firing.

Line 460 computes the new altitude for the lunar lander. An object that is speeding up in a certain time moves a distance the sum of two numbers: the velocity at the start of the time period multiplied by the length of time, and the change in velocity multiplied by the time period divided by two. Mathematically this is: $S = (V1 - V0) * T/2 + V0 * T$ where V0 is the velocity of the object at the start of the time period and V1 is the velocity of the object at the end of the time period.

Finally, line 520 loops the program if the spaceship is above ground. If not, lines 560 and 590 reprint the ship's final statistics. Line 610 congratulates the player if the ship touches down gently and line 620 describes the change in the lunar surface if the landing is rough. The player is given a chance to improve his skill (and the sound of his engines) in lines 660 to 690.

Orbits revisited

Dr. Milan Chepko of Thief River Falls, MN, sent me the program shown in listing 2. Orbits was originally described in the Aug 80 issue. Dr. Chepko has successfully converted it to the TRS-80.

If you have a program you have converted from one of my columns, or if you have a short but interesting game or some

other application aimed at the computerist seeking amusement, send it to me in care of IA. If it has sufficient novelty—or can be made to have—I will be glad to include all or part of it in a future column, crediting you for the contribution. □

LISTING 1

```

10 REM      LUNAR LANDER WITH "SOUND"
20 REM
30 REM
40 REM SET VALUES
50 REM
60 T=0      'TIME
70 H=4800   'ALTITUDE
80 HO=H     'OLD ALTITUDE
90 V=50     'VELOCITY
100 F=500   'FUEL
110 A$=CHR$(128+6)+CHR$(128+4) 'FALLING SHIP
120 B$=CHR$(128+38)+CHR$(128+4) 'FIRING SHIP
130 C$=CHR$(128+54)+CHR$(128+52) 'LANDED SHIP
140 REM
150 REM DISPLAY SURFACE
160 REM
170 CLS
180 FOR I=960 TO 1022
190 PRINT @I, CHR$(128+48);
200 NEXT I
210 REM
220 REM GAME LOOP
230 REM DETERMINE IF PLAYER IS MAKING THRUST NOISE
240 REM
250 TH=0
260 OUT 255,4
270 IF INP(255)>127 THEN TH=3
280 IF F<TH THEN TH=F
290 REM
300 REM ERASE AND DRAW SHIP; PRINT STATISTICS
310 REM
320 PRINT @980-INT(HO/320)*64, " ";
330 PRINT @980-INT(H/320)*64, " ";
340 IF TH=0 PRINT A$;
350 IF TH<0 PRINT B$;
360 IF H<320 PRINT CHR$(8);CHR$(8);C$;
370 PRINT @40,"ALTITUDE=";H;" ";
380 PRINT @104,"TIME=";"T/5;" ";
390 PRINT @168,"VELOCITY=";V;" ";
400 PRINT @232,"FUEL=";"F;" ";
410 REM
420 REM COMPUTE NEW STATISTICS
430 REM
440 HO=H
450 F=F-TH
460 H=H-(1-TH)/10-V/5 'S=(V1-V0)*T/2+V0*T WHERE T=1/5
470 T=T+1
480 V=V-TH+1
490 REM
500 REM CHECK LANDING AND LOOP IF NOT
510 REM
520 IF H>0 THEN 250
530 REM
540 PRINT FINAL STATISTICS AND RESULTS
550 REM
560 PRINT @40,"ALTITUDE=0 ";
570 PRINT @104,"TIME=";"T/5;" ";
580 PRINT @168,"VELOCITY=";V;" ";
590 PRINT @232,"FUEL=";"F;" ";
600 PRINT @360;
610 IF V<11 THEN PRINT"GOOD LANDING";
620 IF V>=11 THEN PRINT"THE MOON HAS NEW CRATER";
630 REM
640 REM ASK FOR NEW GAME
650 REM
660 PRINT @424,"PLAY AGAIN (Y,N)";
670 INPUT Y$;IF Y$="Y" THEN RUN
680 IF Y$<>"N" THEN 660
690 CLS:PRINT"MISSION CONTROL, OUT."

```

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LISTING 2: "Orbits" converted to the TRS-80.

```

100 / ORBITS
110 / INTERFACE AGE, AUG 80
120 / MODIFIED FOR TRS-80 BY MILAN D. CHEPKO
130 / THIEF RIVER FALLS, mn 56701
140 CLS:PRINTAB(30):"ORBITS":PRINT
150 DEFINT I,J,T
160 INPUT"NUMBER OF ORBITING OBJECTS =":I
170 DIM G(I),X(I),Y(I),U(I),V(I)
180 FOR I=1 TO I
190 CLS:PRINT"FOR ORBITING OBJECT #":I
200 INPUT" GRAVITY =":G(I)
210 INPUT" X-COORD (0-127) =":X(I):IF X(I)<0 OR X(I)>127 THEN GOTO210
220 INPUT" Y-COORD (0-47) =":Y(I):IF Y(I)<0 OR Y(I)>47 THEN GOTO220
230 INPUT" X-SPEED =":A:U(I)=A/100
240 INPUT" Y-SPEED =":A:V(I)=A/100
250 NEXT I:CLS
260 FOR I=1 TO I:FOR J=1 TO I
270 IF I<>J THEN X=X(J)-X(I):Y=Y(J)-Y(I):D2=X*X+Y*Y:G=G(J)/(D2*SQRT(D2)):U(I)=U(I)
    +G*X:V(I)=V(I)+G*Y
280 NEXT J:NEXT I
290 CLS:FOR I=1 TO I
300 Y(I)=Y(I)+V(I):X(I)=X(I)+U(I)
310 IF Y(I)>=0 AND Y(I)<48 AND X(I)>=0 AND X(I)<128 THEN SET(X(I),Y(I))
320 NEXT I:GOTO260

```

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Radio City Station
New York, New York 10101

CIRCLE INQUIRY NO. 13



A Multi-Tasking Basic

There are several elementary concepts in computer programming. These include assignment ('let' statements), iteration ('for-next' statements), decision ('if-then' statements), subroutines ('gosub - return' statements), and input/output ('print' and 'input' statements).

There is an additional concept, however, that has been around about as long as the others in conceptual form, but has rarely been implemented. The most common languages, Fortran, Cobol, and Basic don't even address the concept—the result being that few programmers have the opportunity to work with it. The concept is *multi-tasking*.

When you run a program in Basic or most any other language, every statement is executed sequentially, i.e., one at a time. Even when you call a subroutine, only one operation is going on at any point in time. If, however, you had some means of causing several things to occur at the same time, such as processing two or more subroutines concurrently, you would have multi-tasking.

Why, you might ask, would one want to do several things at the same time? Consider a program that is accepting input data from a set of joysticks, processing this data into X,Y position information, and displaying a graphic image on a CRT that shows your "position" on a racetrack based on the X,Y data. From the user's standpoint, he is "driving" a car around the track by controlling his speed and direction with the joysticks. There are obviously three tasks being performed: data input, position processing, and graphics generations. Although most languages force you to perform these operations sequentially (figure 1), they are actually independent—from the standpoint of processing. They obviously share some of the same data, i.e., variables, but since they are execution-independent, they can run independently at the same time.

Seeking a new language

Although we are used to thinking in terms of sequential processes, it is clear that many programming tasks are not sequence-dependent and would benefit from the multi-tasking concept, if only we had a language that provided it to us. What I propose are a few minor changes and additions to Basic that do just that.

From the programmer's standpoint, he will have a language with an additional set of instructions that he can set up to execute tasks concurrently in much the same way that he now sets up and executes subroutines. Any portion of the program that constitutes a functionally distinct task consists of any sequence of statements, including 'gosub' to normal subroutines, and is terminated by a 'terminate' statement (listing). 'Terminate' is, in a way, comparable to 'return' in that it signifies the end of the routine, but it simply stops the processing of the task; it does not return to any other statement in the program.

The general format of the 'terminate' statement is:

TERMINATE task number, ...task number

The list of task numbers is optional. When omitted, as in the listing, it indicates that the task in which it appears is to be terminated. When one or more task numbers are specified, it indicates other tasks identified by number are to be terminated no matter where they happen to be in processing.

We now know what a task looks like and how to stop it once it is running. Obviously we need a means to start it—something comparable to a 'gosub'. We get it in an 'initiate' statement as follows:

INITIATE task specification, ...,task specification

Each task specification consists of the line number of the first program line for the task, optionally followed by a task number. If the task number is omitted, the task is unidentified, which simply means that it cannot be explicitly terminated by a 'terminate' statement containing a task number specification (of course it *can* be terminated by a simple 'terminate' statement in the task itself).

If the task number is included in the task specification, it is the programmer's responsibility to ensure that there is currently no other task active (running) with the same number. Such numbers must be positive non-zero numbers. The

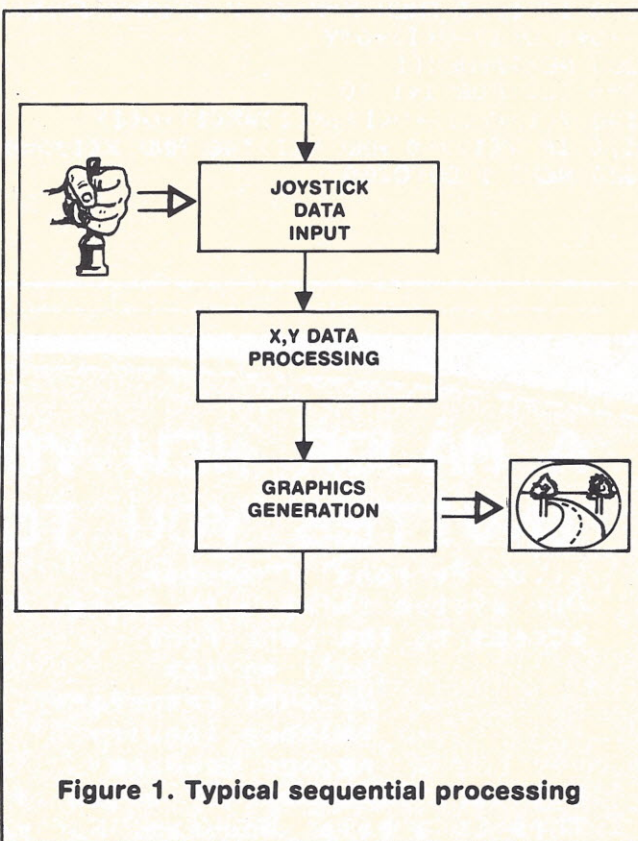


Figure 1. Typical sequential processing

whole purpose of the task numbers is to provide the program with control over the active tasks and to be able to selectively terminate the tasks. Note that it is possible to initiate the *same* task more than once at the same time—an interesting and potentially powerful feature.

In order to start the three tasks of the listing so that they would all begin at the same time and continue independently, we can use a statement such as

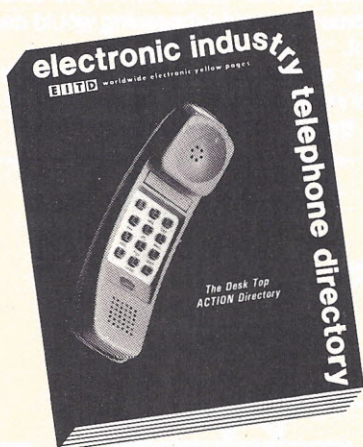
```
50 INITIATE 250,1,590,3,840,4
```

in which we have assigned task number 1 to the joystick task, number 3 to the X,Y processing task and task number 4 to the graphics generation task. Note that the numbers do not have to be in any order and, to be unidentified, the comma must still appear if another task specification follows. Also—and this is very important—after line 50 is executed, the three



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specified tasks are now running, and processing of the instructions after line 50 will continue independent of the other active tasks. It does *not* wait for those tasks to finish before proceeding as would be the case with a 'gosub'.

Since in multi-tasking we want one task to stop processing until some special condition occurs in another, we will provide a statement of the following form:

WAITFOR logical expression

where the logical expression is any expression valid for an 'if' statement. 'Waitfor' would cause the task to stop at the current program line until the specified expression is logically true. For example the statement

10 WAITFOR X=3

would have the same effect as

10 IF NOT (X=3) THEN GOTO 10

While it might look like an unending loop, remember that there would (hopefully) be some other task being executed at the same time that at some point would perform a 'let X = 3'. At that time, the 'waitfor' statement in the other task at line 10 would become true, and processing would continue on the next statement.

The 'waitfor' statement provides, among other things, a means of synchronizing tasks. Another means of synchronization would be the following statement:

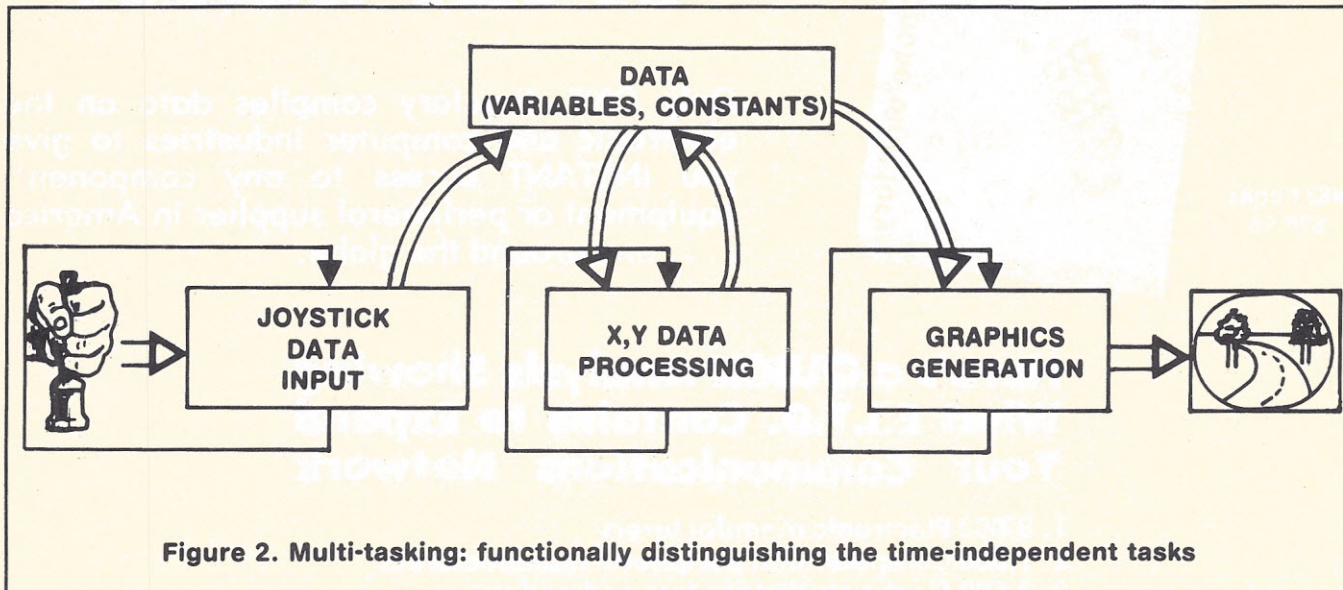
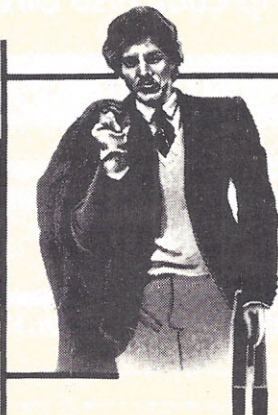
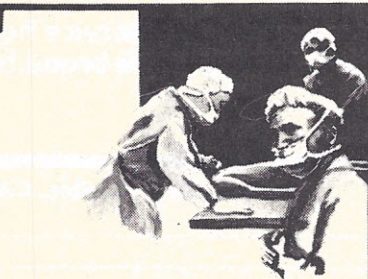


Figure 2. Multi-tasking: functionally distinguishing the time-independent tasks

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```

250  REM INPUT JOYSTICK DATA TASK

```

```

— executable statements which perform the
— input joystick data task

```

```

570  TERMINATE

```

```

580  REM

```

```

590  REM X,Y DATA PROCESSING TASK

```

```

— executable statements which perform the
— X,Y data processing task

```

```

820  TERMINATE

```

```

830  REM

```

```

840  REM GRAPHICS GENERATION TASK

```

```

— executable statements which perform the
— the graphics generation task

```

```

970  TERMINATE

```

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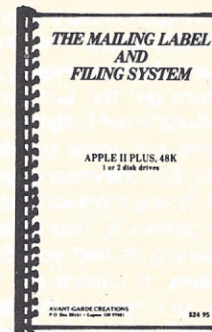
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CIRCLE INQUIRY NO. 66

INTERFACE AGE 25

Learning with Micros

by Louis E. Frenzel

Educational Software—Is There Really Any Hope?

I have discussed the lack of educational software for microcomputers elsewhere, but it is such an important subject that it bears further inquiry. Just where will consumers and teachers get the CAI for the micros they bought incited by the educational ballyhoo?

There are some teaching programs for the more popular micros. But they represent only a fraction of the need and demand. If you have looked or shopped for CAI or other educational software, you know what I mean. It is frustrating and maddening to find so little available amid all the rhetoric and promises. If micros are so great for education, how come there isn't more software?

Looking at the present status of the educational software field, most of the materials are drill and practice math for

grades 1 through 8. There is some material for the same age levels available in English, reading and spelling. But there is a void of high school and college learning programs in all fields. What little exists was developed by teachers for specific needs. Virtually nothing is available to the public. Further, little if any CAI is available for an adult in a career or general interest area. And the burgeoning industrial government training market has still to enter the picture.

Looking at the sources of presently available CAI, we see that it comes primarily from very small companies and individuals. The computer manufacturers have a few programs but for the most this is only a fraction of the total. With the possible exception of Atari, the micro manufacturers have contributed little to good teaching software. And I do not think it is wise or practical for anyone to look to them as big future contributors.

The rest of the software comes from user groups and special organizations. The various Radio Shack, Apple, Commodore, and Heath/Zenith groups offer a hodge-podge of CAI and educational software. Special nonprofit government funded organizations such as Conduit are making significant contributions, but it will be years before they can satisfy the need.

So why aren't more people tackling educational software? The need, the demand and the market are obviously there. So are a variety of good distribution channels. Any developer of

**The development
of educational software
is so disappointing
that one wonders whether the
concept of teaching with micros
is as widespread
as supporters claim.**

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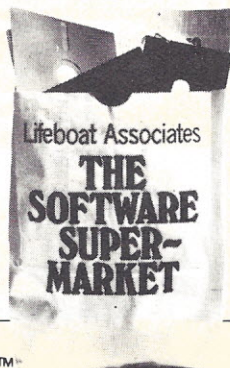
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quality CAI will find thousands of waiting customers. Teachers and schools who bought computers to aid in learning are fast discovering that there are few viable software sources. And most of them are not willing or able to develop their own.

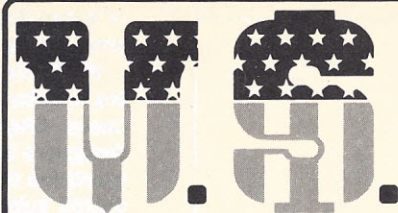
Maybe CAI is too hard to develop. Authors with subject matter expertise, instructional design capability, and programming skill are almost impossible to find. Perhaps the problems of supplying CAI in different formats for various computers are simply too great. Maybe it is the future compatibility problem that publishers foresee, as fickle microcomputer manufacturers update, change, and replace their machines without warning as the markets dictate or as new technology becomes available.

It appears that this is a job for the big publishers: McGraw-Hill, Prentice-Hall, Addison-Wesley. Rumor has it that they have been studying the opportunity and researching the problems. But there are still no major programs. Maybe some are forthcoming.

There are few alternative solutions, that's why I believe the big traditional publishers offer the greatest hope. They have the technical manpower, financial strength and distribution nets. By developing an on-going link with the major micro manufacturers, there seems to be little standing in their way.

Unless it's why should they? Maybe the interest and widespread use of microcomputers are not as important as some would have us believe. Perhaps the market isn't really there. And, who knows, maybe the technical development problems are too difficult to solve right now. Despite the need, maybe the big publishers do not feel responsible for developing CAI, especially if they can't make a profit from it. ☐

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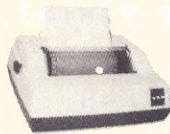
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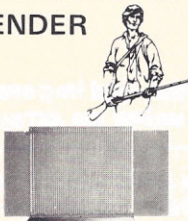


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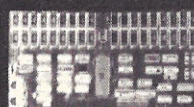


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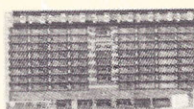
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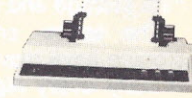
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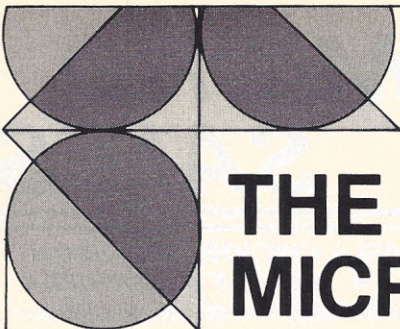
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THE MICRO-MATHEMATICIAN

by Douglas H. Haden

Arrays: Sequential Data Storage Part I

The most compact structure for storing data is the array, where data items are stored in consecutive locations in memory. When data items have their structural divisions at regular, equal-length intervals (such as rows and columns of tabular data), arrays can also provide a time-efficient form for data storage and access.

The space- and time-efficient characteristics of array storage have moved language designers to include arrays in virtually every high-level programming language. Let's see how arrays are used in several compiler level programming languages—where they are generally called indexed variables

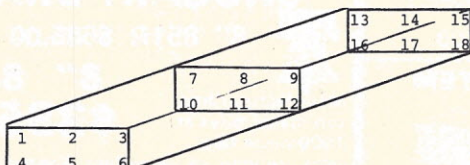
T[1]	6.1	J[1,1]	9
T[2]	-4.3	J[1,2]	1
T[3]	9.0	J[2,1]	4
T[4]	0.0	J[2,2]	-3
T[5]	8.5	J[3,1]	12
		J[3,2]	84

the vector T consisting of the values 6.1, -4.3, 9.0, 0.0, and 8.5

the matrix J consisting of the values 9, 1, 4, -3, 12, and 84

	column ₁	column ₂
row ₁	9	1
row ₂	4	-3
row ₃	12	84

the matrix J in tabular form



the array A consisting of the first 18 integers in a $2 \times 3 \times 3$ form

Figure 1: Various representations of arrays, matrices, and vectors.

or subscripted variables; then examine the implementation of array storage and retrieval operations.

While the syntactic designators of subscripted variables are not standard, parentheses and brackets account for most cases. Character-set limitations have forced many language designers to use parentheses (Basic, Cobol, and Fortran are examples of programming languages that use parentheses to delimit subscripts). This causes an ambiguity when function and array references occur in the same environment: is F(I) the function F of the argument I or the I-th value of the array F? Where available, brackets are the preferred syntactic designator of subscripts.

Terms defined

Singly subscripted variables (also called singly dimensioned variables) are usually referred to as vectors. Vectors are simply some number of values stored in consecutive memory locations. Doubly subscripted (or doubly dimensioned) variables are called matrices and correspond to two-dimensional tables. Variables with more than two subscripts are called arrays. Figure 1 shows some examples of subscripted variables.

Some programming languages provide only vector-type arrays. This is especially common in small Basic implementations on microcomputer systems. (We'll see shortly how we can overcome limitations to the number of subscripts.) Vectors are especially easy to implement and exist in almost every compiler level computer programming language.

In most languages, there are two statement types required to use vectors (or any type of array): a nonexecutable declarative statement to cause the compiler to allocate space for the vector and some number of executable imperative statements to store data values in the vector and to retrieve data values from the vector.

In some programming languages, especially Basic, if a vector is referenced by an imperative statement with no corresponding declarative statement, the vector is assumed to consist of 10 or 11 elements (values) by default. Figure 2 shows example declarative and imperative statements for a Basic vector.

Programming languages that allocate space for arrays by nonexecutable declarative statements are said to use static

```

250 DIM V(10)
    :
300 LET V(8)=3.14159
    :
400 LET K=8
410 PRINT V(K)

```

Figure 2: Declarative and imperative statements for creating and using an array in Basic.

allocation. Once space is allocated, it cannot be deallocated (freed) or changed. While most programming languages use static space allocation, some use dynamic allocation, which permit arrays to be allocated and deallocated at will. APL, for example, permits arrays to be dynamically allocated and re-allocated by use of the reshape operator ρ . The vector with the value 1 2 3 4 5 6 can be reshaped into the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$ by the APL statement $X \leftarrow 2 \rho X$.

In most programming languages, subscripts are assumed to start at zero or one and be the successive positive integers 1, 2, 3,... In some languages (e.g., Pascal), subscripts can be

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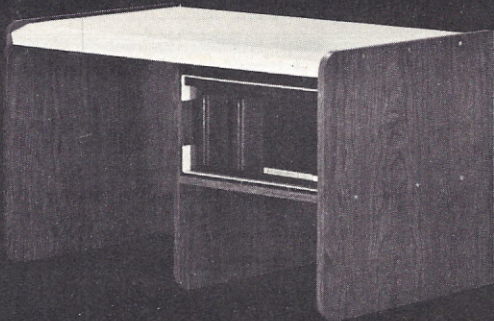
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```

DIMENSION V(10)
:
V(8) = 3.14159
:
K = 8
WRITE (...) V(K)
:

a FORTRAN vector

[1] X+3 4p0
[2] X[2;3 4]+8 5
[3] X[1]+6 7 9
:
creating the 3-by-4 array
      6  0  0  0
      7  0  8  5
      9  0  0  0
in APL

01 EMPLOYEE-TABLE
02 NAME-NR OCCURS 200 TIMES.
03 EMPL-NAME.
04 LAST-NAME PICTURE X(18).
04 FIRST-NAME PICTURE X(12).
04 MI PICTURE X.
03 EMPL-NR PICTURE X(8).

an employee name-and-number array in COBOL

int v[10]
char m[24][80];

declaration of a vector and a matrix in C

```

Figure 3: Arrays in Fortran, APL, Cobol, and C.

negative and other than integers. Some examples are given in figures 3 and 4.

The Fortran example in figure 3 is analogous to the Basic example in figure 2. Statement [1] of the APL example uses the reshape operator to create a 3 x 4 array of zeroes. Statement [2] inserts the values 8 and 5 into columns 3 and 4 respectively of row 2, and statement [3] inserts the values 6, 7, and 9 into rows 1-3 of column 1. The power of APL's subscript operator is substantial.

The Cobol example shows the creation of a 200-row, 2-column array of employee name and number. The employee

```

CONST
MONTHS = (JAN,FEB,MAR,APR,MAY,JUN,JUL,AUG,SEP,OCT,NOV,DEC);

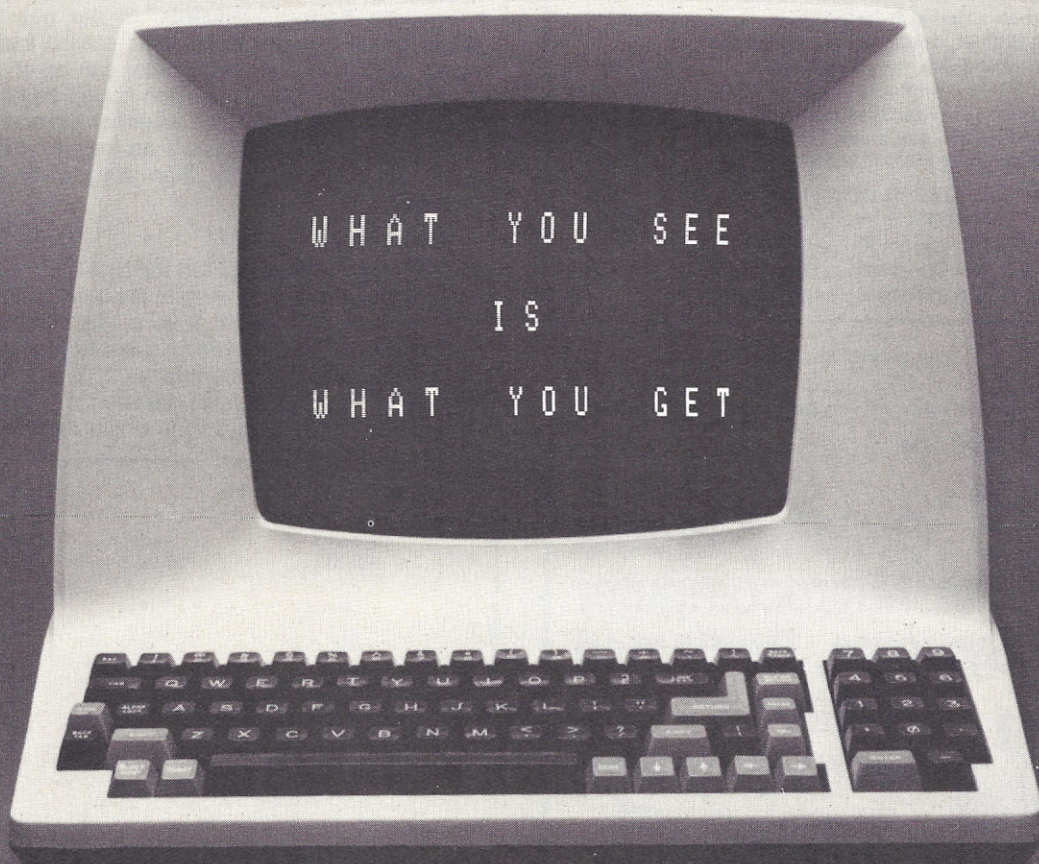
VAR
ANNUALPROFIT : ARRAY [1957..1986] OF REAL;
INCOME       : ARRAY [MONTHS] OF REAL;
IMAGE        : ARRAY [-100..100,-2..2] OF BOOLEAN;
MONTH        : MONTHS;
QUARTINCOME  : REAL;

BEGIN
:
QUARTINCOME := 0;
MONTH := JAN;
WHILE MONTH <= MAR DO
BEGIN
QUARTINCOME := QUARTINCOME + INCOME[MONTH];
MONTH := SUCC(MONTH)
END
END

```

Figure 4: Arrays in Pascal.

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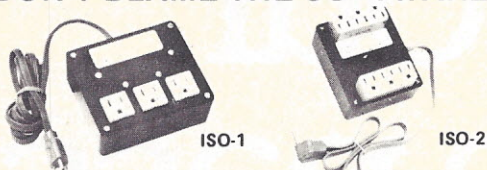
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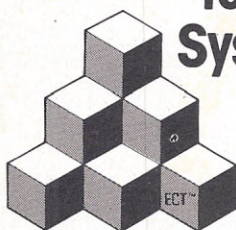
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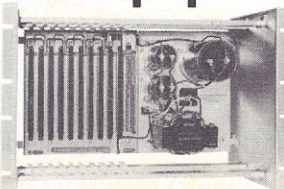
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name has addressable subfields. The last example in figure 3 shows the declaration of a 10-element integer vector and a 24 x 80 character vector in the C programming language.

C starts numbering its subscripts with zero, as do most Basics, but C only allocates the specified number of elements. Thus, v[0]-v[9] are available from a declaration of v[10], but v[10] is not. Similarly, the subscripts of m must be 0-23 and 0-79.

The Pascal programming language is appropriate for illustrating some of the more versatile subscripting concepts. The example in figure 4 shows a 30-element real vector 'annualprofit' with subscripts 1957, 1958, ..., 1986. The vector 'income' consists of 12 elements with subscript values Jan, Feb, ..., Dec. 'Image' is a 201 x 5 matrix of Boolean values whose row subscripts are in the range -100 to 100 and whose column subscripts are in the range -2 to 2.

The program shows the summing of 'income[Jan]', 'income[Feb]', and 'income[Mar]' to produce 'quartincome'. (The function 'succ' returns as its value the successor of its argument.)

It is worth noting the new ANS Fortran-77 standard gives full-language Fortran and more general array declaration than in previous Fortran standards. In the new standard, the dimension declarators (the values placed inside the parentheses of 'dimension' statements) can be of the form d₁:d₂ where d₁ is the lower dimension bound and d₂ is the upper dimension bound. The value of either dimension bound may be negative, zero, or positive as long as the value of the upper bound is greater than the lower bound. Thus, the statement

DIMENSION A(-5:5,10)

causes space to be allocated for an 11 x 10 array A.

Vectors are relatively easy to implement. If the starting or base address of a vector V is b, the i-th element of V is located at b + i (for zero-origin subscripts: 0, 1, 2, ...) or b + i - 1 (for one-origin subscripts: 1, 2, 3, ...). Basic is usually zero origin. Thus, DIM V(10) declares an 11-element vector. APL can be either zero or one origin depending on system

<u>memory address</u>	<u>zero origin</u>	<u>one origin</u>
b	V[0]	V[1]
b+1	V[1]	V[2]
b+2	V[2]	V[3]
b+3	V[3]	V[4]
⋮	⋮	⋮

Figure 5: Storage of zero- and one-origin vector arrays.

default and modifiable by the 'origin' command. Fortran is a one-origin language by default but may be declared zero origin in ANS full-language Fortran-77 standard implementations. Cobol is a one-origin language and, as we have seen, C is a zero-origin language. Pascal is neither one nor zero origin implicitly—such is established by explicit declaration as shown in figure 4. Unless otherwise stated, we will assume one-origin subscripting from here on. (Zero-origin subscript formulas may be created by adding one to the one-origin formulas.) Figure 5 compares zero- and one-origin array storage.

Part II concludes next month with a discussion of array and implementation starting with matrix arrays, and describing how to add arrays of an arbitrary number of dimensions to languages with as few as one script. □

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BUSINESS SOFTWARE REVIEW

By Carl Heintz, CPA

A Superior DBMS

This month we will focus on the DBMS Series 20 from Condor Computer Corp., Ann Arbor, MI, one of the truly unique pieces of software to be reviewed in quite some time. It sells for \$700, which makes it one of the more expensive entries, yet is worth the price.

DBMS (data base management system) is a series of programs written in assembly language designed for CP/M with at least one floppy and 48K of memory. The edition reviewed was supplied on single density 8-in diskettes. The advantage of implementation in assembly language becomes evident upon first usage—the system runs incredibly fast. It allows the user to utilize CP/M capabilities including Submit and, in some releases, a configuration that starts the DBMS programs on boot-up.

The manual states that the DBMS system is a programming language instead of merely some application programs. In a

manner of speaking, this is true since the system shares some of the syntactical elements associated with a language such as Basic. The power of the "language" comes from the ability to implement commands that operate upon the data base in machine code as opposed to the slow and sometimes awkward methods utilized if a language such as Basic is used as the intermediary.

Here are some of its specifications:

- Up to 32,167 records per file
- Up to 1023 bytes in a record
- Up to 127 fields per record, and up to 127 characters per field
- Numeric data can be as large as 21,483,736.47

DBMS begins by defining a data base—i.e., determining a name of up to eight characters under which data will be filed. Note, though, that DBMS associates all of these files with the data base name. This allows a user to have more than one data base on the same disk at the same time—for example, the manual gives these sample data bases that might coexist on a disk:

- Gledger—the general ledger
- Journal—the journal entries data base
- Jouraudit—the audit trail data base

The next step is to define the format under which the data base will be updated and displayed. This is done at user discretion: literally a blank screen is presented and the user designs the layout. The cursor can be moved in any direction any place on the screen: data can be entered up/down, left/right, down/up, or even hither/thither.

The user can specify as many fields as necessary, up to the maximum indicated above. Further, edit tests can be invoked to determine the data type, i.e.:

Alphanumeric

Alpha only

Numeric only

Dollar

Required (i.e., this field cannot be skipped)

Once a format has been defined and the data screen set up, the screen can be printed out exactly as it appears.

The designers of DBMS recognized that there are several types of data entry sequences, including those for unique records, those where matching records are entered, and entry sequences in which one data base is merged with another. Unique data entry can be most easily grasped when thinking of an accounting system. There is only one record for each general ledger account—one and only one master general ledger account. The input sequence should recognize that duplicate master accounts are not acceptable. Under DBMS, this function is supported.

Further, when data is entered, some form of test must exist to determine that there is a matching "master record". Again, back to the accounting example, the best illustration is the case of a journal entry. Some existing master account (a general ledger account) must exist for a valid journal entry to be accepted. DBMS supports this function.

Finally, in many data base applications (a majority I would assume), it is useful to take two data bases and merge them into a third, combination data base. DBMS supports this function. In the little accounting example above, posting the journal entries to the general ledger master records is analogous.

DBMS has commands that allow for one item in a data base to be operated mathematically or logically, and the result entered in the same or another field. This allows, in the simple case, preparation of percentage reports or summations.

The 'post' command matches records from one data base file by a specified item with another data base item, updating the latter and creating another data base. The 'select' command selects data base records meeting specified conditions and creates a 'result' data base of those items.

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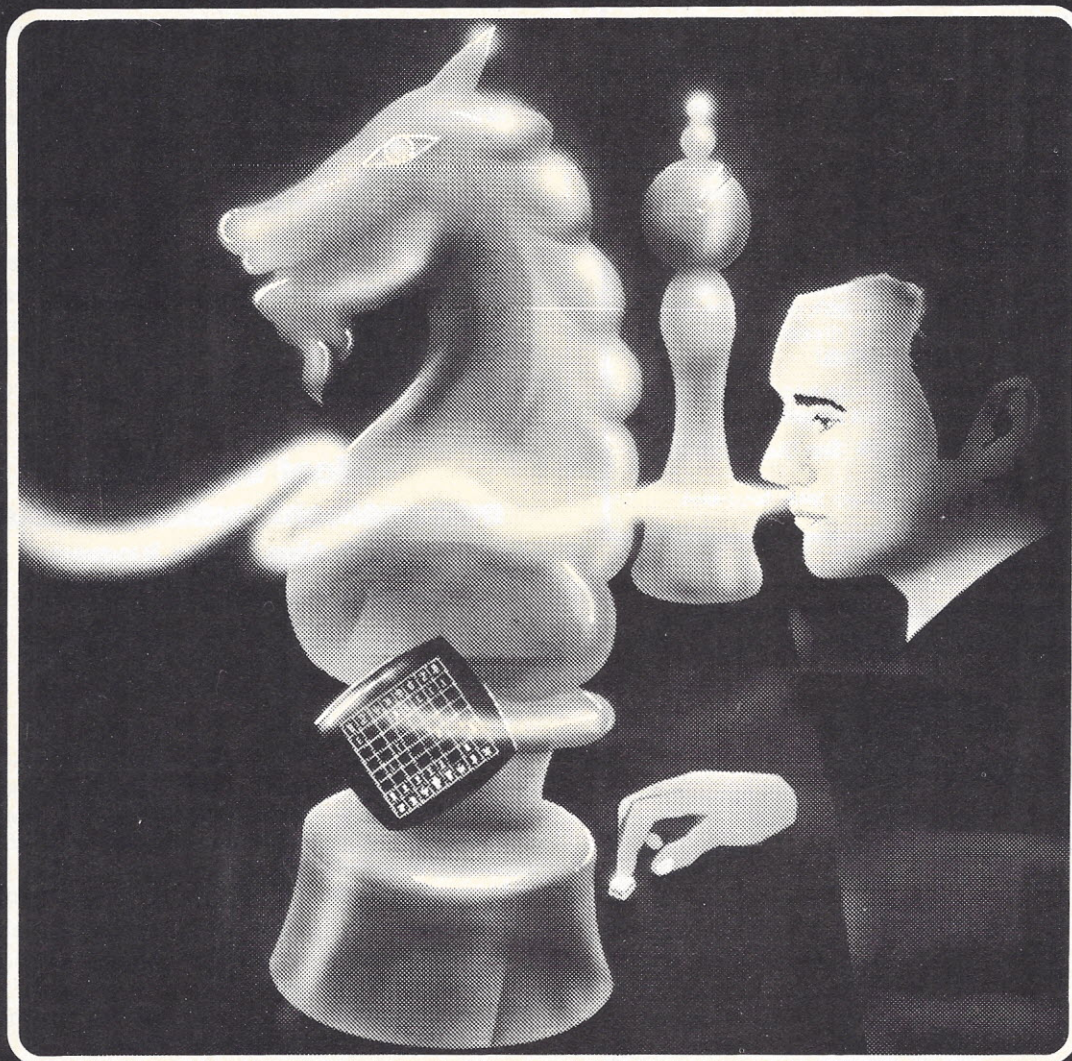


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And, of course, DBMS programmers included a nice little sort routine that allows for the sorting of data base items under a number of specifications.

The 'stax' command allows the user to calculate statistics for specific data items. It can be used, for example, to set accumulators to add up all debits and credits for journal entries. It can also be used to scan and print the cumulative total of specified fields. For example in a time-reporting system, the data base could be quickly scanned for all time charged to a particular job.

Most data base management systems are written by programmers for programmers, which assume that the user knows what he is doing. DBMS is a radical departure from that design philosophy. The commands are simple and the syntax is as close to English as any micro system available. Consider, for example, the following command sequences (taken at random to illustrate the syntax)

A: compare journal gladder not matching account
(translation: compare journal records to gladder records by matching account; output all those not matching)

A: sort gladder by account
(translation: sort the gladder file by account number)

A: Enter journal
(translation: enter data to the journal data base)

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out any additional software or programming. Unlike anything else on the market, to my knowledge, DBMS allows the user to design a custom applications program in which programs become transparent to the user.

At press time, four new commands were added:

- 'read'—interprets files created under CBasic or MBasic thus creating files under those languages that effectively interface with DBMS.
- 'write'—outputs parts or all of the data base into a format that can be read by CBasic or MBasic.
- 'reorg'—allows for the addition or deletion of fields from a data base.
- 'destroy'—as it implies—eliminates a data base.

If this sounds good, it is...and it's all backed with documentation that is easy to read and master. The system can be put in the hands of someone with little or no experience with a micro and, in a matter of hours, can produce some useful results.

Additionally, scheduled for release this month or next (Jan or Feb 81) is level II of DBMS, which as the author of the programs told me, is intended to be the next step for the DBMS-20 user. It has 11 additional commands that allow for sophisticated applications to be implemented even easier.

Without a doubt, DBMS is among the best software products to be introduced in a long time. It's easy to use, flexible, and has a power and speed unmatched among the software currently available for micros. If the reader has an application for a data base system, DBMS from Condor gets a 10 +. □

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CIRCLE INQUIRY NO. 7

64 Kilobytes— and Bank Select Too

A review of DMB6400 dynamic memory board

by Roger H. Edelson

Last month I covered the first entry by Measurement Systems & Controls, Inc. (Orange, CA) into the S-100 memory board market; this month I look at its top-of-line model, the DMB6400, which features a full 64K bytes of storage—with bank select.

In the broader sense, both boards are implemented as dynamic memories and use the same memory chip—the 4116, 16,384X1-bit dynamic RAM. My feelings about dynamic memories remain the same—with or without bank select: at a minimum, they should have

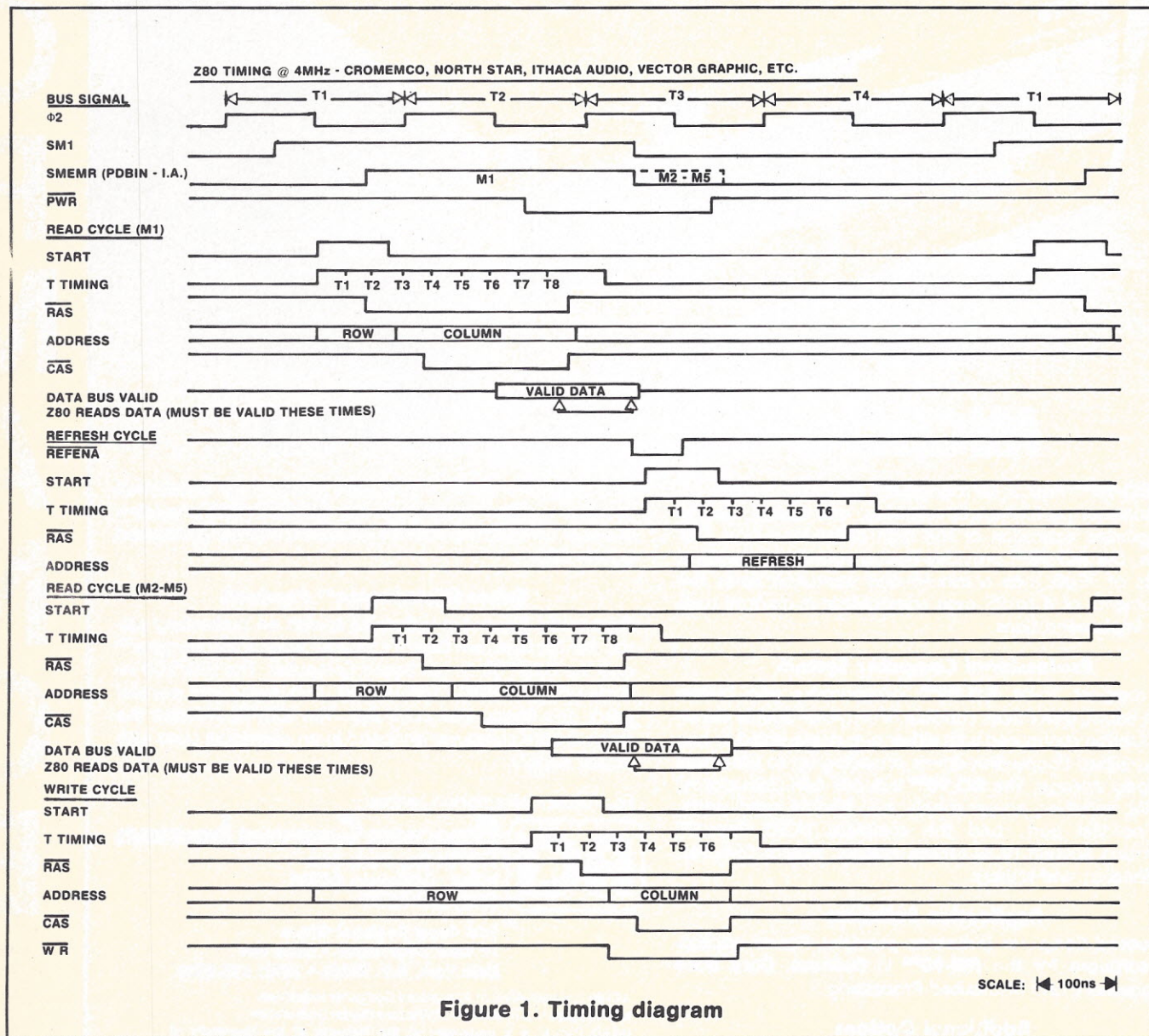
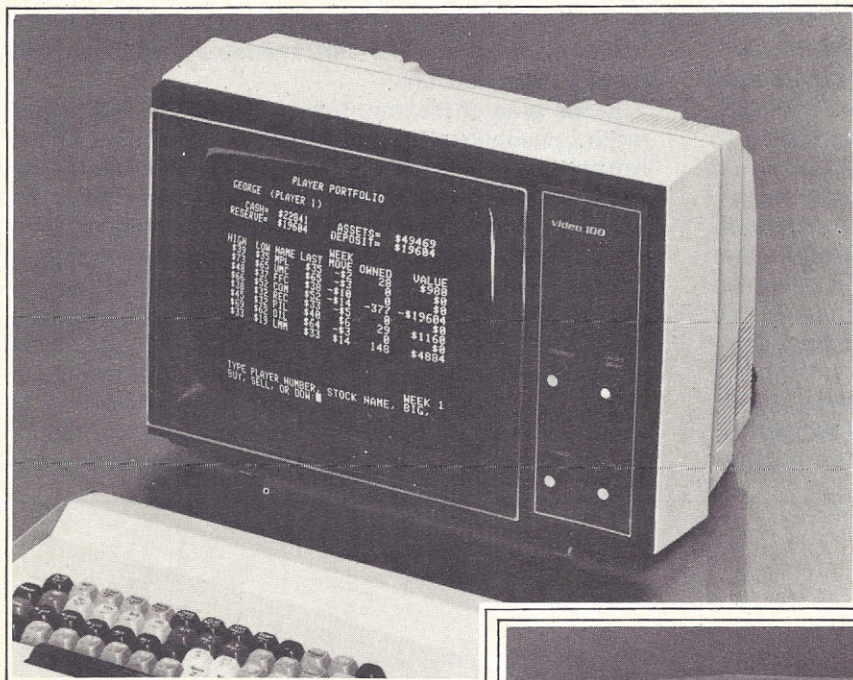


Figure 1. Timing diagram

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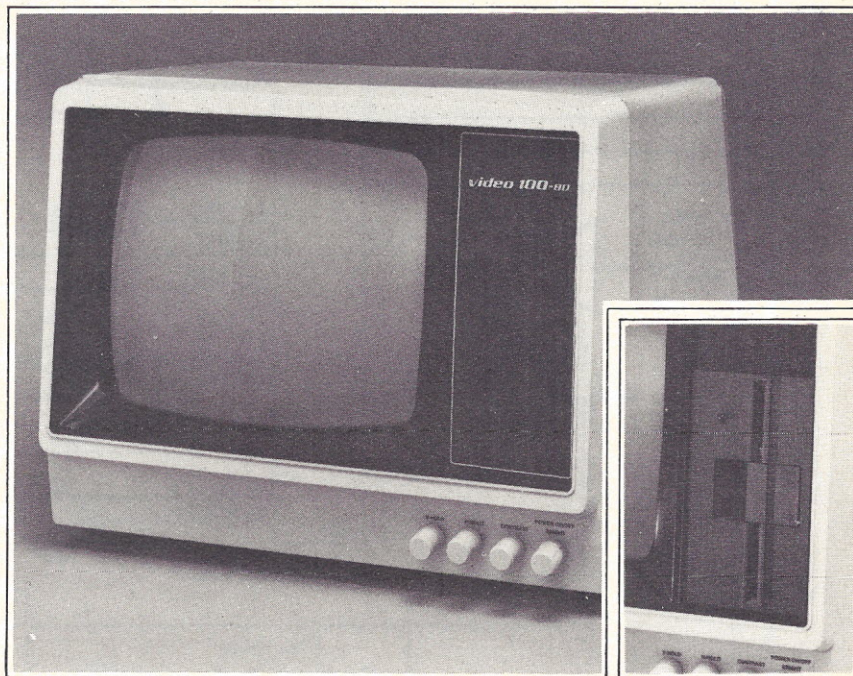
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The board shares a somewhat minor operational deficiency with its non-bank select brethren—neither support the 8/16-bit convention nor the extended addressing mode established by the proposed IEEE standard. Advertisements for this board no longer imply that it meets all the proposed conditions, only that it will meet timing protocols; the technical manual states, however, that the board meets the latest attempt by the IEEE to standardize the S-100 bus. I do not feel

In the area of memory timing, the DMB6400 uses a more conventional approach to the generation of the refresh timing signals than does the DM6400. Delay lines are the order of the day here, rather than the 25 MHz oscillator technique used in the design of the earlier board. Figure 1 illustrates how the timing signals relate to the sync input, and the timing relationships for the refresh signals as established by the 40-nsec resolution delay lines; figure 2 shows that part of the schematic where this timing chain is implemented.

The selection of which S-100 bus signal to use to initiate a memory cycle is made through the jumper wiring on header 1; this allows the user to customize

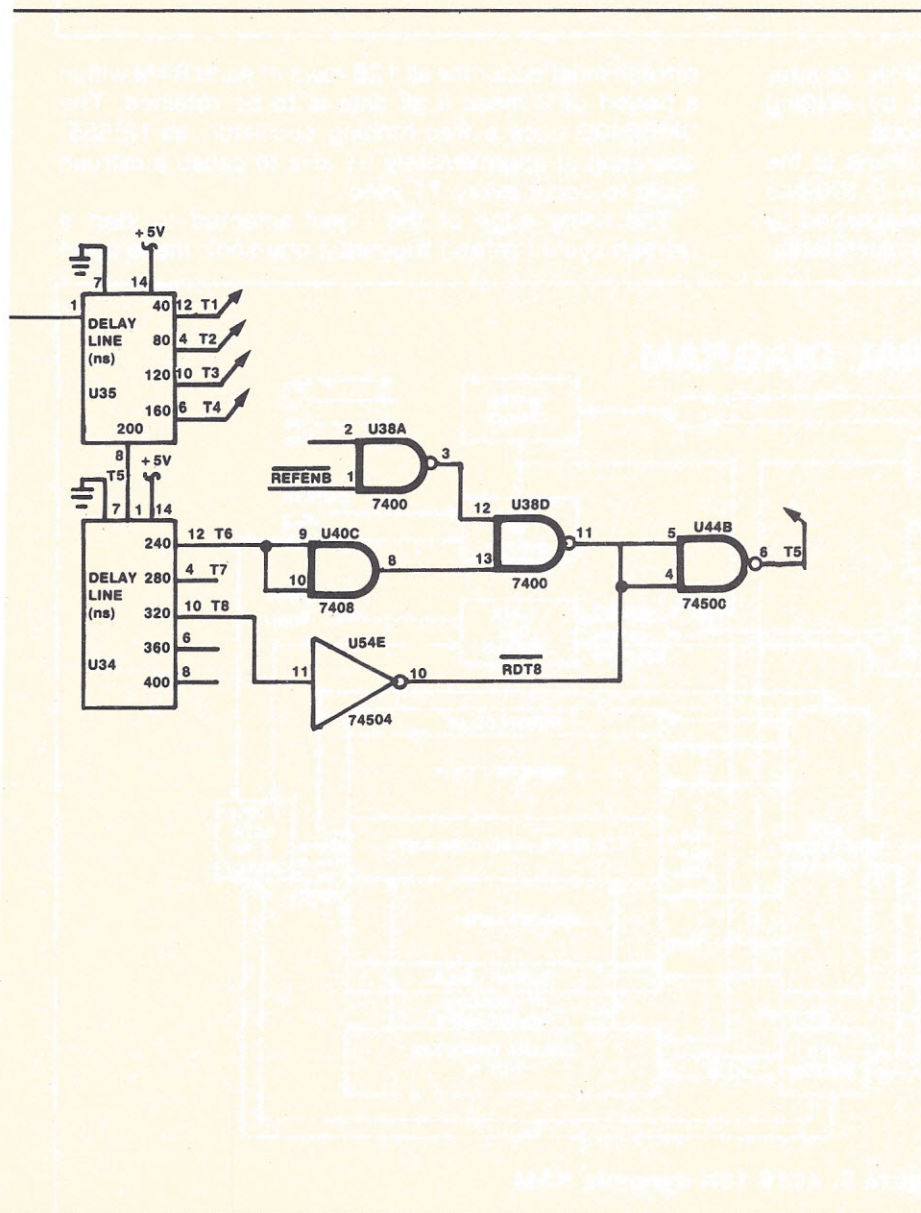


the timing as required for his particular S-100 CPU. The header customization is sufficient to allow this memory board to work with all 8080 CPU boards, most Z80 implementations, two different 8085s, and even the Marin chip M9900. Table 1 illustrates the signal list for header 1, along with jumper interconnects.

Once the memory initializing signal occurs, the delay lines generate the timing signals required by the MC3480 dynamic memory controller to generate the basic refresh and address control signals required by the 4116s (RAS*, CAS*, WR*, REFEN, and ROWEN). These signals were also generated by the same integrated circuit in the non-bank select version, however the timing inputs were obtained from the 25 MHz clock oscillator rather than the delay lines, as in the DMB6400.

The read and write cycles each require a 16-bit address from the S-100 bus, and the MC3242 (16K dynamic RAM address multiplexer and refresh counter) is used to multiplex the least significant 14 bits into the necessary two sets of row/column 7-bit addresses. The row and column address lines on the 4116 are multiplexed on the save seven lines in order to reduce the pin count on the package. This produces a 16-pin integrated circuit with the ability to address 16K locations (figure 3).

In order that a dynamic board be of significant usefulness, the refresh activity must take place without the requirement for any overt action by the CPU; the refresh cycle must be performed transparently to the CPU operation with no need for halt or wait states. The DMB6400 executes the refresh operation during an unused portion of the CPU timing cycle, either



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CIRCLE INQUIRY NO. 10

Pin	Signal Name
1	SM1
2	PSYNC
3	SMEMR
4	PDBIN
5	8080REF
6	PU
7	REFEN
8	RDENB
9	RDEN
10	START 2
11	START 1
12	PSYRD
13	DY50
14	No Connection
15	No Connection
16	DYIN

This variation in the initializing signal timing is the only difference in the refresh cycle for any S-100 bus CPU. The refresh timing requirement is established by the memory IC and the 4116 data sheet indicates that

The rising edge of the signal selected to start a refresh cycle ('refen') triggers a one-shot, made up of

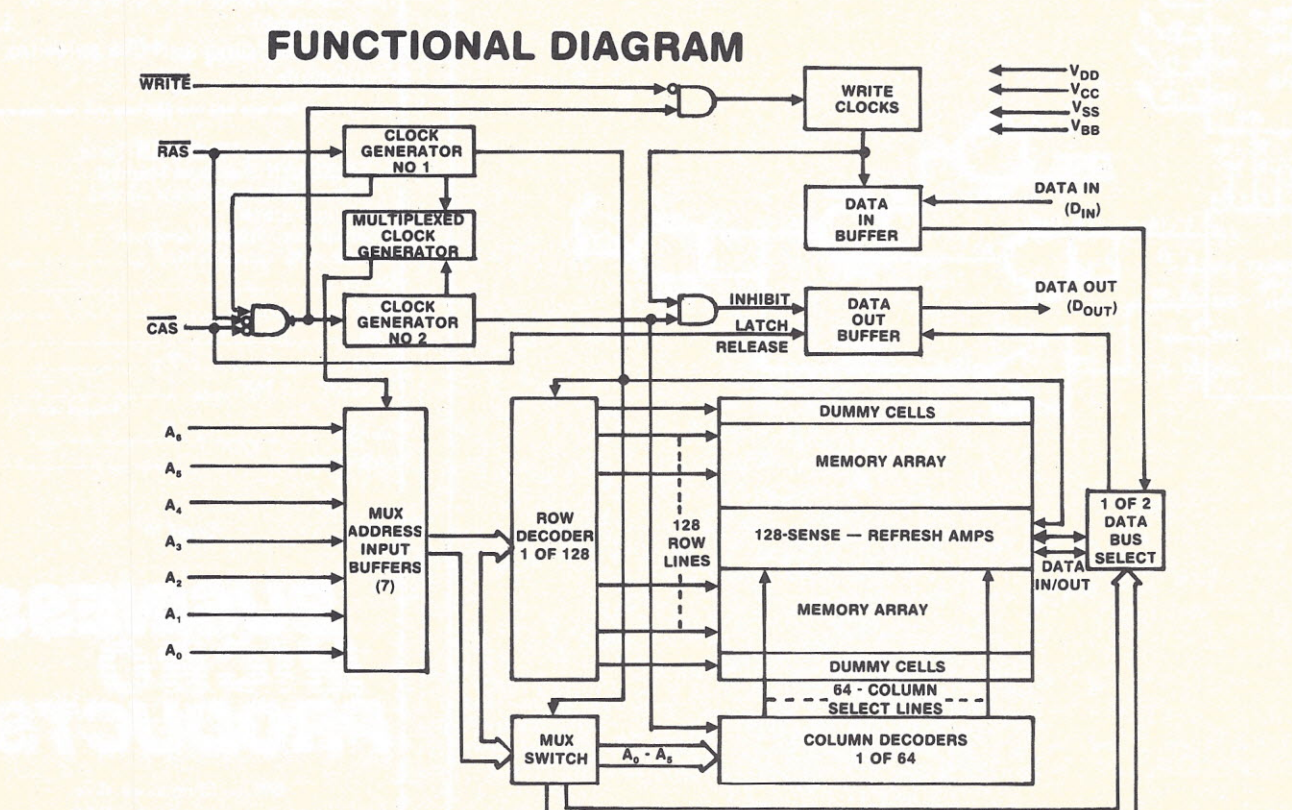
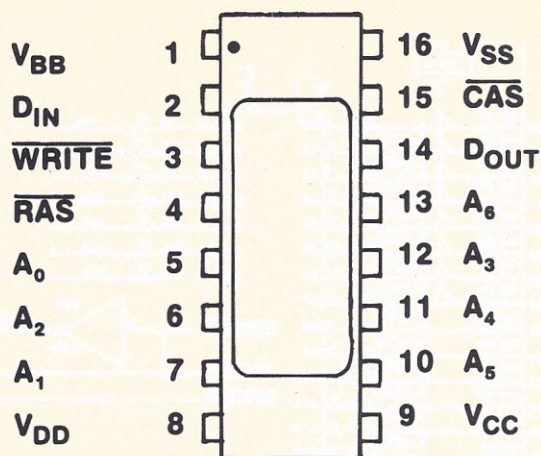


Figure 3. 4116 16K dynamic RAM



PIN NAMES

A_0 - A_6	ADDRESS INPUTS
CAS	COLUMN ADDRESS STROBE
D_{IN}	DATA IN
D_{OUT}	DATA OUT
RAS	ROW ADDRESS STROBE
$WRITE$	READ/WRITE INPUT
V_{BB}	POWER (-5V)
V_{CC}	POWER (+5V)
V_{DD}	POWER (+12V)
V_{SS}	GROUND

Figure 3b. Pin connections

two inverters and a 2N2369A transistor, which generates a 60 nsec logic-0 pulse. If neither 'preset*' and 'pwait' are not asserted, the pulse ('refema*') initiates a memory refresh cycle. The 'refen' signal also enables the refresh counter to increment by one count.

As this is a refresh cycle and not a read or write cycle, once the 'start' signal goes to a logic one, beginning the generation of the memory timing signals T1 through T8, the MC3480 is in the refresh mode and all four 'ras*' outputs go to a logic 0. In this case, CAS^* and R/W^* are not generated, resulting in a single row of 128 bits in all 32 RAMs being refreshed simultaneously.

Timing cycles compared

Both the read and write memory cycles share some of the same timing as the refresh cycle; the major difference between read and write is the status of the signal $SM\ WRITE^*$ which is used by the 3480, and therefore the 4116s to differentiate between the read and write operation. This signal, $SM\ WRITE^*$, is generated from the S-100 bus write strobe signal, PWR, and SEL^* , a signal generated on the DMB6400, which indicates if the bank select conditions have been met. The starting signal for either a read or write cycle is CPU dependent as shown in table 1 and is of necessity different from the refresh initiating signal.

Once the read or write cycle is initiated, a pulse of approximately 100 nsec width propagates through the two delay lines, U35 and U34. Therefore, 40 nsec after the start of the memory cycle, T1 goes to a logic 1 state and sets one of the four RAS^* lines to a logic 0. The appropriate RAS^* line is determined by the state of the signals present on the S-100 address lines A14



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One difference between the write and read cycle is that PWRB is Nanded with SEL (the bank select condition signal) to initiate the write operation as opposed to the cycle start signal used for the read cycle. Also, at T2 time, 'smwrite*', the same signal as above, is a logic 0 causing R/RW* to go to a logic 0 forcing data to be written to the memory devices. Further, the MC3480

Figure 4. Termination/filtering

The input termination/filtering technique used by this memory board for the critical control lines and the



address signals is illustrated in figure 4. The use of the 200-ohm resistor and 47-pf capacitor feeding into a buffer chip results in an active termination that very effectively suppresses S-100 bus line noise, overshoot, and other transients.

This design is compatible with either terminated or unterminated "mother" boards and meets the proposed IEEE standard with the exception of address lines A0 through A7, which slightly exceed the current loading specifications in the worst case.

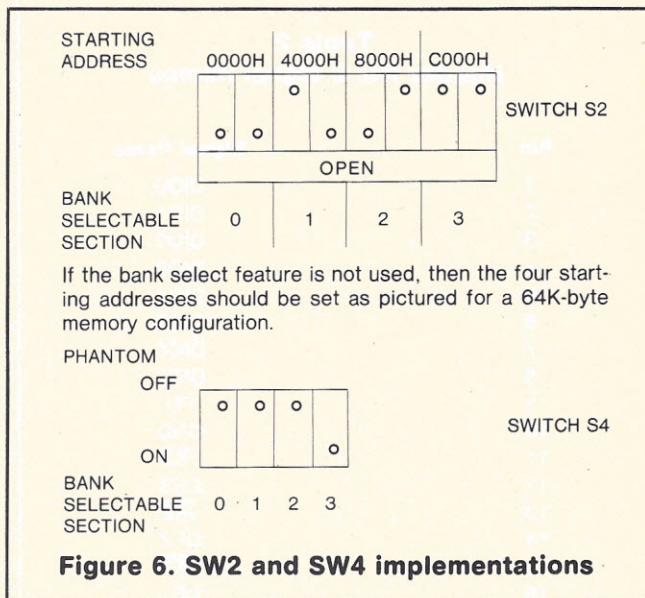
The major difference between the DMB6400 and the DM6400 is the addition of circuitry to provide the bank select feature. In this implementation, it is not just the entire board that is bank selectable, with the memory array configured of four independent bank selectable sections of 16K bytes each.

The bank select flip-flops, U37 and U42, are initialized during any system turn-on or reset by the action of the S-100 bus signal 'preset*'; at this time the states of the bank select initialization-set switch, SW1, are transferred to these bank-select flip-flops through their preset and clear lines (figure 5). Each flip-flop that has been set to a logic 1 state represents a bank selectable section that is enabled on, with its corresponding LED lit.

Software control of the bank select feature will override the hardware initialization states. Header 2 gives the user the flexibility to utilize either of the two most common bank-select schemes—the Cromemco/Alpha-Micro, or the North Star. For compatibility with the Cromemco method, any of the eight data lines, DIO0 through DIO7, can be wired to the four J-K inputs on the bank select flip-flops (U37 and U42). This allows

any combination of the eight data lines to turn on or off any, or all, of the four bank selectable sections.

Thus with only one I/O command, the state of all banks can be changed, and the banks may be configured to any multiple of 16K bytes. To be compatible with the North Star, all four J-K inputs are wired to the



one data line DIO0. This single data bit determines whether the addressed banks are to be turned on or off. The other data lines are wired as desired to each of the inputs of the four 2-input NAND gates according to the user's bank select requirements. In this implementation, one I/O command is needed to turn on the

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banks, and another I/O command is required to turn them off. This signal list for header 2 is given in table 2.

The settings of switch SW2 determine where in the 64K memory space the selected 16K banks are to reside. Dual comparators are used to compare the

Table 2
Header No. 2 signal names

Pin	Signal Name
1	DIO0
2	DIO1
3	DIO2
4	DIO3
5	DIO4
6	DIO5
7	DIO6
8	DIO7
9	PU
10	GND
11	JK3
12	DE3
13	JK2
14	DE2
15	JK1
16	DE1
17	JK0
18	DE0

settings of this switch with the two highest order address bits (A14 and A15), allowing each 16K section to be assigned any one of four possible locations (0000H, 4000H, 8000H, or C000H). Also, to make the board still more versatile, the 'phantom*' line can be independently enabled for each of the four sections.

While the design of the DMB6400 is definitely superior to an implementation that makes the whole board one massive bank, there is an attendant disadvantage: no segments smaller than 16K can be disabled. This design imposes a restriction on those microprocessors that use some memory space for either a disk controller, an arithmetic processor, a Prom, or other devices, must lose at least 16K of memory space. In my North Star Horizon II, I was forced to reduce my system to 48K in order to test this board, with an attendant reduction in size of my CP/M operating system.

The circuit design of this memory board is top notch. Note the liberal use of filter capacitors (figure 7) and the short distances from the edge board connector to the termination/filtering network. Also, all the voltage forms required by the circuitry are generated by integrated circuit regulators rather than the Zener diode used by some boards. Both the +5 volt and +12 volt regulators are TO-220 style packages with more than adequate heat sinking for their power dissipation; the board really runs cool.

The LEDs, which indicate the state of the bank select conditions (labeled CR2-CR5), are located at the top edge of the board for easy visibility. This feature is only useable during troubleshooting, as the computer will usually be fully enclosed. The configuration set switches are not quite as conveniently placed as they were on the DM6400, but in reality one does not often change the board configuration once it has been set up. The dynamic memory integrated circuits are actually better arranged than was the case in the DM6400, and there is no need for the top-of-the-board +12 volt bus. For the user requiring a full 64K bytes with bank select, and can stand the occasional error of dynamic memory, this is a memory worth remembering. □

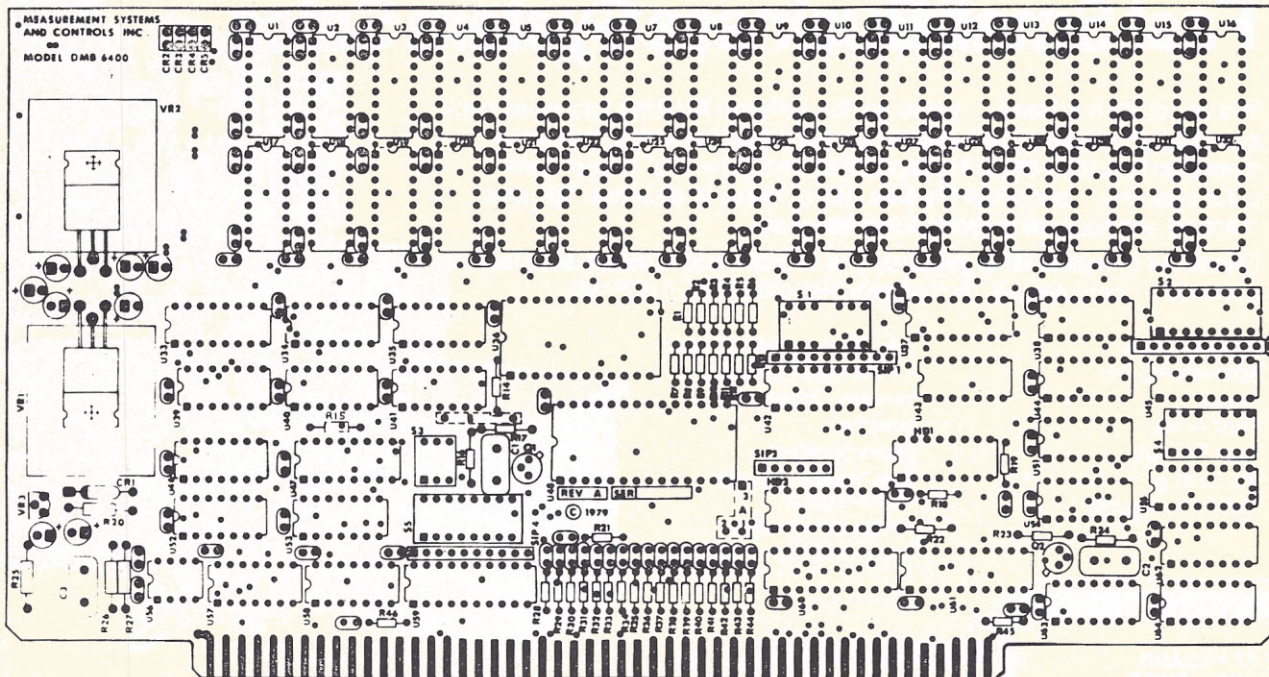


Figure 7. DMB6400 layout

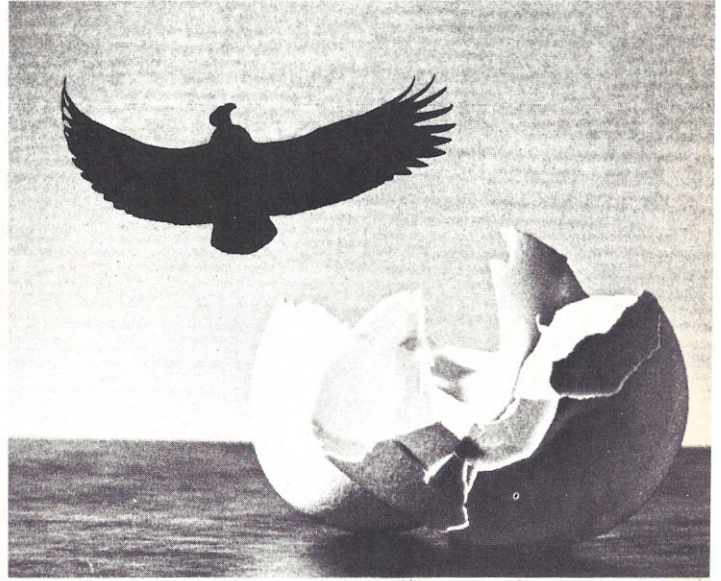
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C20-3



The Pascal Microengine

by Tom Fox

Computers think one way; humans, another. That fact is the root of why computers are so difficult to understand. Computers operate in electrical current flows in organized patterns. "Organized" is the operative word here. How the organization is planned and arranged is the basis of that ambitious human activity called *computer programming*.

The first computers were programmed on their own terms, in a language called "machine." Little, if any, consideration was given to making the task easy for the people doing the work. Not much machine language programming is done today; there's a better way. The science soon evolved a better concept: assembly language. In this, the computer is put to work converting more human-readable instructions into the native machine language of the computer itself.

Ease of programming improved markedly, but assembly language programming is still a tedious form of communicating with a computer. It is quite difficult, and an intimate knowledge of the machine's internals is a must. The task is even more awesome when you realize

that each brand of computer has its own assembly/machine language combination. IBM 370s and Z80s—and all variations in between—share little in common at the basic level of their respective native languages.

Most programming today is done in more familiar languages such as Basic, Cobol or Pascal. High-level computer languages like these were designed with the programmer/user in mind. Their function, however, is essentially the same as that of an assembler: to translate people-understandable commands into machine-readable instructions.

The greatest (yet largely unrealized) goal of the higher level languages is the concept of transportability. Ideally, a Basic program that works on one brand of computer should perform properly on another—even though the fundamental components of the two machines are executing vastly different instructions as the program runs.

When Niklaus Wirth invented Pascal, he designed it for a computer that did not, at that time, exist. He called his idealized computer the pseudo-machine. Its machine language was dubbed pseudo-code; P-code for short. P-code was optimized to realize the peculiar yet powerful potential of the Pascal language itself. No

compromises needed to be made to adapt Pascal to the limitations of any existing computer hardware or its machine language.

In order to run a Pascal program, a computer needs an extra piece of software called a "P-code interpreter." This is yet another translating program that makes the physical computer respond to commands as if it actually understood the P-code instructions themselves. P-code interpreters, however, add a significant processing load to the computing process, forcing the machine to thrash around trying to be what it is not—a pseudo machine. As a result, computers executing P-code run a lot slower than they should.

One of the most elegant ideas in the recent history of microcomputing was realized about two years ago when Western Digital, a southern California integrated circuit manufacturer, announced its Pascal Microengine. This cleverly-titled device is a microprocessor whose native machine language is Pascal P-code. Suddenly, the no-compromise language found a no-compromise home.

The Microengine wasn't an entirely new design. It was based on Western's existing MFP-16000 device. This is a set of five 40-pin integrated circuits that form a 16-bit microprocessor. Two of the chips do the work, while the other three contain the actual instruction set. Each of these micro read only memories (Microms in Western's parlance) holds 512 22-bit words forming the personality of the microprocessor itself. In earlier incarnations, the MFP-16000 was equipped with Microms making the device a Digital Equipment LSI-11.

The most popular current version is the WD-16, the heart of the Alpha Microsystems line of computers. The device can run at a speed of up to 3 MHz, but is held to 2.5 MHz in the computer we are looking at this month.

Associated Computer Industries (Irvine, CA) is the subsidiary of the \$20-million Western Digital Corp., which markets Microengine-equipped computer products. Its biggest seller is the ACI-90, a dual floppy diskette stand-alone computer. In appearance, the machine is simple and unremarkable. The entire unit is

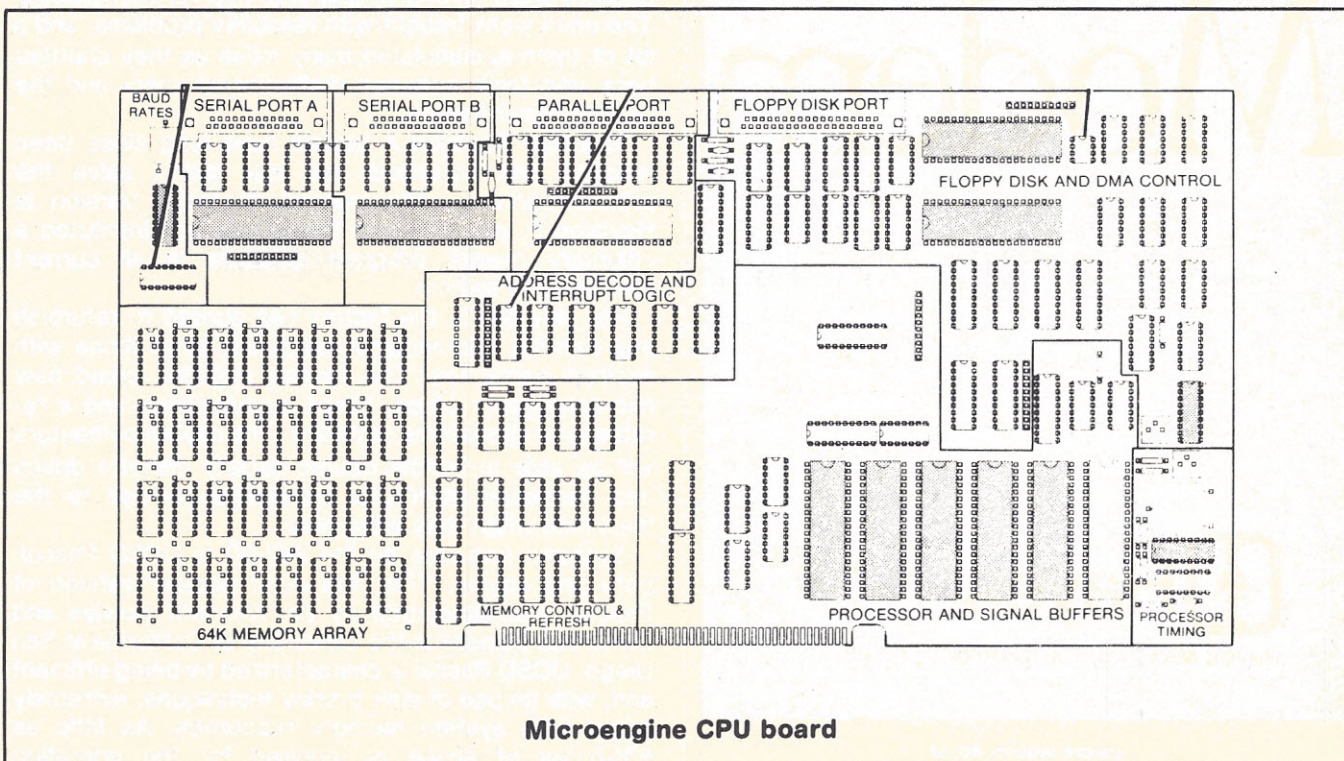
contained within a compact desk-top box measuring 18-in wide by 6-in high and 21-in deep. The front panel is dominated by a pair of openings for standard-size 8-in floppy diskettes. The only controls are a lighted power switch and reset button.

Inside, the diskette drives take up nearly all of the available space. At the rear is a deceptively tiny power supply. This is a "switching" supply, a design showing up in more and more of today's generation of computers. A switching power supply is far more efficient than earlier linear designs. It carries a double advantage: damaging heat buildup is minimized, and the world's ever-dwindling energy reservoir is conserved. The rear panel of the ACI-90 is taken up by power and interface connectors and a tiny cooling fan of the muffin type. The flat top of the computer is free of any cooling vents that would keep you from stacking equipment or supplies on it.

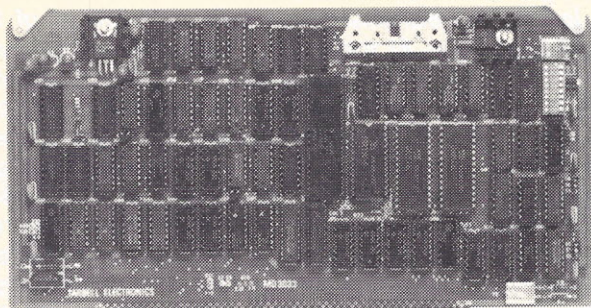
All of the computing electronics are contained on a single 8 by 16-in circuit card mounted atop the diskette drives. The board is amazingly simple, containing only 122 integrated circuit chips. Thirty-two of these comprise the 64 K-byte main array of RAM arranged as 32,768 16-bit words. The Microengine can address up to twice this amount, but there is no provision on the circuit board for the extra RAM chips. While at the ACI factory, we saw a prototype 128 K-byte version with piggyback board and taller enclosure, but this version isn't now in general release.

Several of the remaining integrated circuits on the board are Western Digital's own designs. These include single-chip serial input/output controllers, a floppy diskette drive controller, a baud rate clock generator and direct memory address controller. The computer comes with two serial I/O ports conforming to the near-universal EIA RS-232C specification.

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format for parallel printers. The diskette drive controller can handle up to four separate devices, including the two drives contained within the main housing. The drives can be of single or double density, and single or double sided.

The Control Data 9406 diskette drives supplied are described as "dual density," which isn't the same as "double density." The term means that the drives can be arranged for the single- or double-density format at will. In the ACI-90, this is a tiny switch on the main circuit board. In the double-density format, each diskette can hold up to 512 K-bytes of data on each surface, in a variant of the IBM soft-sectored arrangement. At additional cost, ACI will supply double-sided diskette drives, giving up to 2 M-bytes of on-line storage in this modestly-sized box. Speed performance of the drives is only average, with a 96-msec typical access time. Watching the ACI-90 perform, there is no doubt that these drives are the tightest bottlenecks in system performance. The powerful Microengine deserves a far less restrictive mechanism for storing data.

Linkup with Ascii terminal

The only other hardware is a CRT terminal. This is a modified ADDS Regent 25 with a customized ROM and compatible paint job. Any Ascii terminal with a direct X-Y cursor addressing capability will work fine with the ACI-90, however.

A computer in this class is incomplete without some sort of hard-copy printer (one isn't listed in the ACI catalog). Almost any of the commercially available ones will work, however, since both serial and parallel printer port are provided.

Before talking about the software, we should probably put in a calming word to the nearly 1500 current owners of Microengine-based computers. There is no doubt that Western Digital jumped the gun when it introduced it's first Pascal microcomputers. The product simply wasn't ready, and the pioneering purchasers were forced to discover this for themselves. The units were fraught with reliability problems, and a lot of them accumulated many miles as they shuttled back and forth between disillusioned users and the factory repair bench.

The first Revision A boards have long since been recalled and scrapped, but this didn't solve the problem entirely. The current hardware version is Revision F, and Western Digital has just instituted a voluntary rework program available to all current Microengine owners.

For only \$125, the factory has agreed to refurbish any existing Microengine computer, even those with expired warranties. The rework includes brand new microprocessor chips, board modifications and a re-release of all systems software. The reborn computers will be able to handle double-density diskette drives and hardware interrupts; capabilities denied to the machines when they were new.

Systems software on the ACI-90 is UCSD Pascal, pure and simple. This, the most popular version of Pascal, was developed by Dr. Kenneth Bowles and numerous helpers at the University of California at San Diego. UCSD Pascal is characterized by being efficient and, with its use of disk overlay techniques, extremely frugal with system memory resources. As little as 8 K-bytes of space is required for the operating

system, leaving up to 56 K-bytes for software. Program execution time is extremely fast; an object lesson in what "no compromise" computing can be when it's done right. UCSD Pascal and the Microengine were, quite literally, made for each other.

UCSD Pascal is far more than just a computer language; it is a complete disk operating system and more. It comprises a self-sufficient environment for writing, maintaining and running programs in the Pascal language. Its major components are:

File—keeps track of disk space usage, file names and file types. Includes facilities for file copying, renaming, displaying and printing.

Editor—accepts keyboard entry for building Pascal source programs and text files, such as documents.

Compiler—converts Pascal source programs into runnable P-code. A linker is also available for connecting P-code modules together to form large programs.

Run—executes a compiled Pascal program. In the ACI-90, this is simply a matter of turning the Microengine loose to run its native code. In other machines, 'run' activates the P-code interpreter discussed above.

These modules are overseen by a program that interprets user commands and handles terminal display formats. The same module ties all of the pieces together with a tree-like structure of menus, which act as reminders of the system commands that are active at any given time. The main menu invites you to activate the filer, editor or any of the other modules listed above.

Select one (by entering a single letter on the keyboard) and a new menu appears to give a fresh set of choices. As you use the system, you descend through the menu tree, exploring the Pascal caverns much like a game of Adventure. The difference is that the menus always show a map of the local area, and you can always follow a trail of gingerbread crumbs back up to the surface.

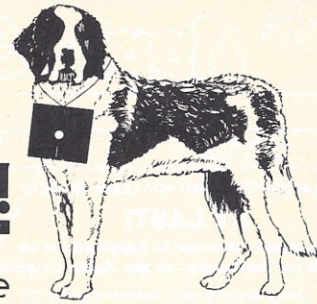
Utility software included

At first thought, it seems remarkable that almost the entire operating system is written in Pascal. In the Microengine, however, nothing could be more natural—remember that the Pascal compiler is the assembly language in this machine. Twenty-four programs and data files are supplied on the ACI-90 software diskette, comprising some 230 K-bytes of information. Included are utilities to adapt the software to your particular terminal device, and a P-code disassembler that is a sort of compiler in reverse. Source listings are not included for any of the programs.

The main Pascal editor is screen rather than line oriented. This is good, since it allows you to view a screenful of text or program while you are making changes to it. The actual editing commands, while powerful, are a bit on the complex side, and seem to require a lot of keystrokes to perform certain tasks. On a scale of 1 to 10, we would give it a 4. It is clearly out-classed by almost any of the current crop of excellent microcomputer text editors—none of which, unfortunately, will run in this machine's Pascal-only environment. The system is supplied with two other text

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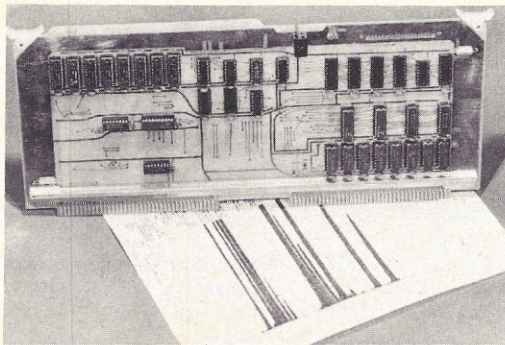
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editors. One is meant for very large files and the other intended for use by Teletype-style hard copy terminals.

We had to run our prime number cruncher benchmark program (IA Jun 80) on the ACI-90 several times before we believed the results. The test typically takes from 3 minutes to an hour to run in its Basic version. The Microengine, however, knocked it off in an amazing 19 seconds! The only other Pascal machine we have tested, a 1.87 MHz 8-bit 8080-based unit, was over six times slower.

Applications software, that crucial element that transforms a computer into a useful business tool, is just beginning to see the light of day on the Microengine. ACI recently acquired an experienced business software firm, and expects to have a wide variety of their Pascal programs running on the Microengine in a short time. This includes general ledger, accounts payable, account receivable, contracts administration, data base inquiry with report generator, and inventory control. A multipriority printing spooler is also planned, as well as an exciting multiprocessor package that can

Applications software... is just beginning to see the light of day...

tie several Microengines together into a network sharing a large Winchester-technology disk drive.

For documentation, the ACI-90 depends largely upon the 220-page *Microengine Reference Manual* available for \$19.95. This is actually two documents assembled together into a softcover binding. The first part is the *Microengine User's Manual*, which describes the procedures for installing and using the hardware portions of the computer. A brief chapter on troubleshooting procedures is included, along with a set of fault-finder flow charts. A theory of operations section is also there. The copy we saw was a bit out of date, however, as it described voltage adjusting procedures for an earlier version of the power supply.

The fattest part of the book is the *Pascal Operations Manual*, which describes in detail how the UCSD variant of Pascal works. It's essentially a traveler's guidebook through the menu tree, giving generous examples along the way. This document is not a good introduction to Pascal, however. For that, the manufacturer recommends Peter Grogono's *Programming in Pascal*, \$13.50 from Addison-Wesley Publishing. Make sure you get the revised edition.

Retail price for the ACI-90 is \$5,695. This includes a pair of single-sided dual-density diskette drives, a full complement (64 K-bytes) of memory and all UCSD Pascal systems software. Substitute double-sided floppy disk drives and add \$800. The ADDS terminal is available for \$1,095. The product is available at some 15 retail dealers throughout the United States and western Europe. □

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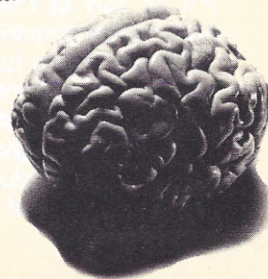
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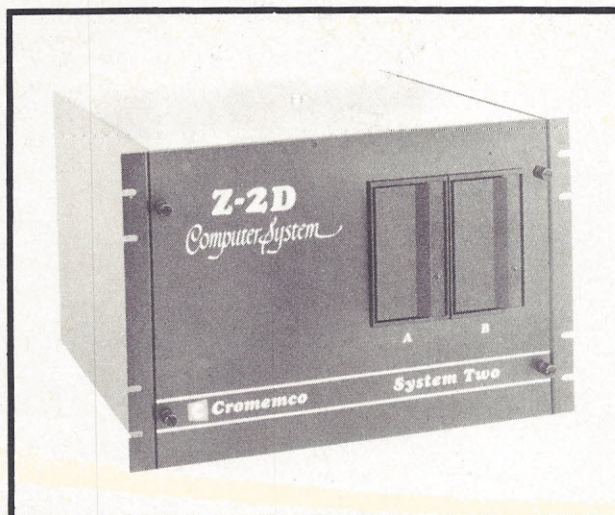
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by Hillel Segal

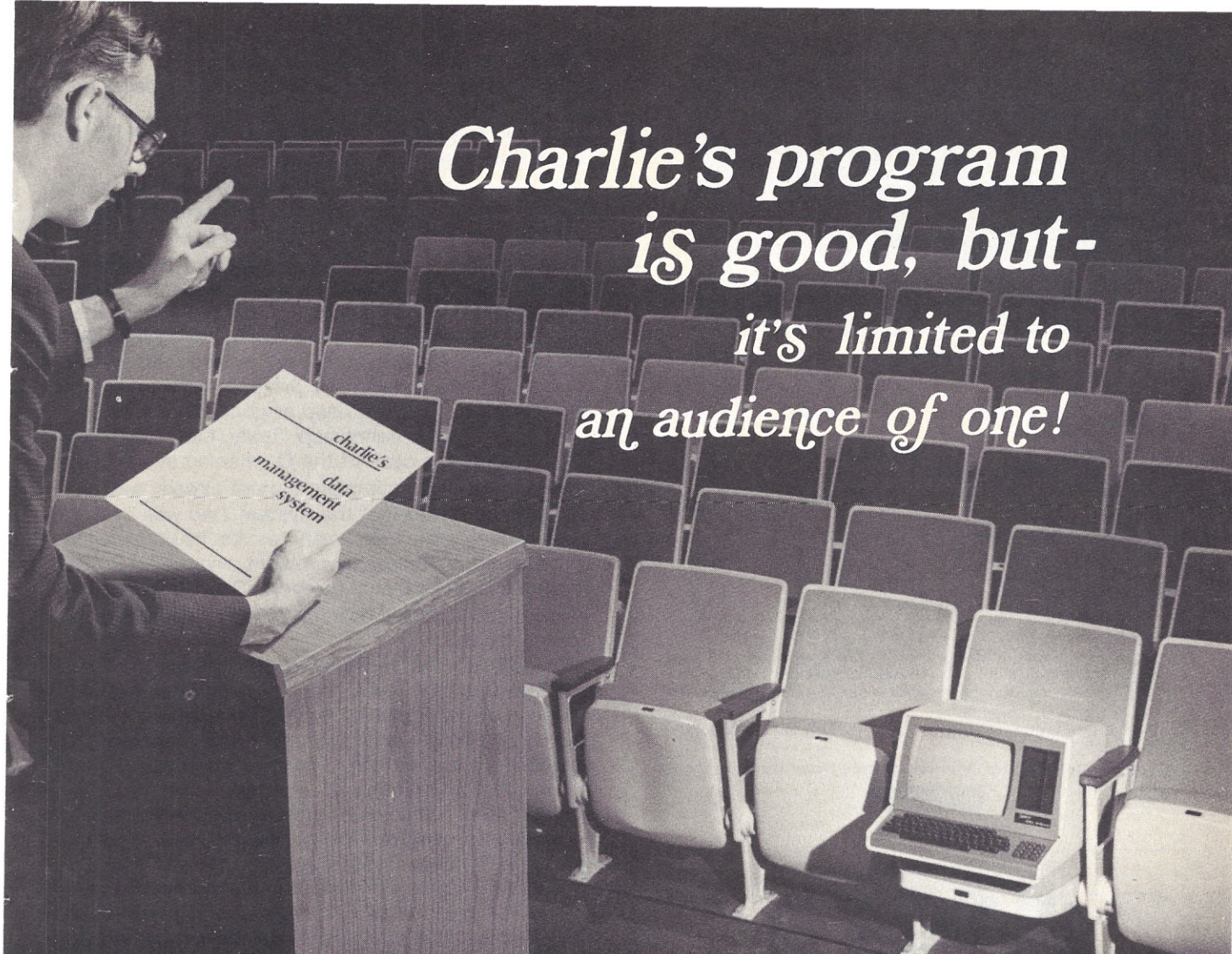
In planning the computing needs of a business, school, or other institution, today's—as well as tomorrow's—requirements must be taken into consideration. The Cromemco System Two and Z-2H offer significant expansion features for computers in the under-\$15,000 class. This aspect is one of several features revealed in benchmark tests the pair underwent as part of the Association of Computer Users' series of Benchmark Reports.

Last month, we began with a look at the role benchmark tests should play in selecting a computer. While the actual speed tests are interesting in themselves and may become a significant factor in the selection of a computer, we concluded that software, support, and the right combination of features were important consider-

ations which must not be ignored. In many instances, for example, software that's well-suited for the purpose intended should take precedence over speed difference, even a difference of two-to-one or more.

The benchmark tests are useful for more than just speed alone, however. Aside from a set of five different benchmark programs, the tests include an ease-of-use comparison for the system editors and a sampling of customer opinions on their computers. In addition, the process of setting up and running the programs on the various computers which undergo benchmark testing often reveals aspects of the operating systems and languages which might otherwise go unnoticed.

Taken altogether, the information provides a very complete profile of the computer's strong and weak



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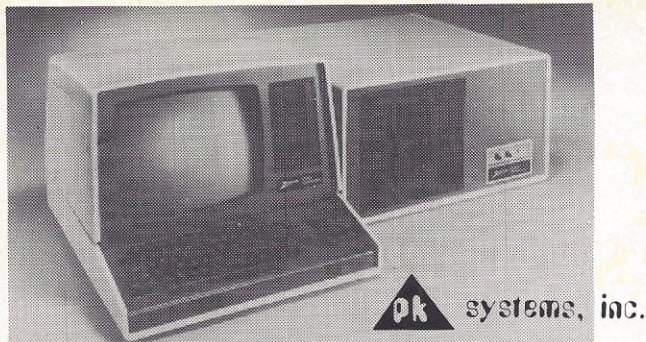
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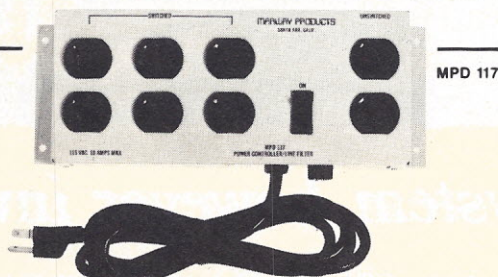
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points. More difficult to evaluate are the merits of particular applications software offered along with each system, either by the manufacturer or an independent supplier. Even the greatest machine isn't much good without a program to run on it, so equal care should be taken in selecting the software.

So much insight can be gained from actually going through the motions of entering and executing a program on a given system, that I definitely would encourage anyone considering a computer purchase to perform some similar exercise on the candidate system. While it would not be practical to run an entire battery of tests, one simple program similar to your own application could tell you a lot about the system; the process of entering and running the program would point out any problems regarding ease or convenience of use.

Where existing benchmark tests have been performed, as in the case of the Cromemco systems, we have a much more complete picture already available. Our tests revealed that the System Two was near the front in most of the benchmark results. Its performance in the accounts receivable problem, finishing in 2:48.0, was not as fast as that of the North Star Horizon; but as we shall see in future columns, it was nevertheless an excellent time.

The System Two tested by our independent consultants included 64K bytes of memory and had two mini-diskette drives. A display screen and keyboard, along with a dot-matrix printer (Centronics Model 3703), rounded out the system. The total price was \$9,275 for this particular package.

When all of the above items are combined with an 11-megabyte hard disk drive, a much more powerful system is created. Called the Z-2H, this package sells for \$15,280. While it doesn't quite fall within our upper limit in this price range (\$15,000), we tested it at the same time as the System Two. The math-oriented tests did not run any faster, but those problems using disk

...one simple program
similar to your
own application would
tell you a lot
about the system.

storage did execute in shorter times. In the account receivable test, the Z-2H finished in 1:08.8, less than half the time of the System Two.

The addition of a hard-surface disk drive brings with it such an increase in speed and on-line storage capacity that the result is a radically transformed system. Cromemco is one of the first manufacturers of inexpensive systems to offer this expansion capability, though others will undoubtedly follow suit as quickly as they can.

Business applications such as inventory, accounts receivable and payable, order entry, and so on are often very hungry for disk space, and the mini-

diskettes which serve the personal computing user so well tend to become bottlenecks when faced with a business application which may be several orders of magnitude bigger. In these cases, the availability of the hard disk is essential.

Small business users may find their needs suited to an inexpensive floppy-disk system, but should be wary. They should be certain that their projected needs for a reasonable period of time (2-5 years) do not exceed

...the addition of multi-user and multi-task capabilities is a significant step upward.

the smaller storage capabilities of the floppies, unless the hard disk can be added later.

No discussion of a computer would be complete without a look at the languages it can handle and the operating systems that's part of it. Here we have something new to report, a development which occurred after the benchmark tests were run on the Cromemco systems.

We tested the System Two and Z-2H in Basic, running them under the CDOS operating system. Two versions of Basic, 16K and 32K in size, plus a multi-user Basic, are available for the system. In addition, Fortran IV, Ratfor (structured Fortran), and Z-80 assembler are available.

Cromemco's new offering is its Cromix operating system. This is a multi-user, multi-task system which includes an optional compiler for the language "C". The new operating system is said to speed up I/O operations to and from the disk drives, and has the ability to keep track of multiple users and their files.

According to a Cromemco spokesman, the Cromix system plus the Z-2H's hard disk add up to a micro-computer with "supermini performance." While this may be an exaggeration, the addition of multi-user and multi-task capabilities is a significant step upward.

Altogether, the expansion capabilities of the Cromemco computers are a significant asset to the user who anticipates substantial growth in demand for computer services, but is able to start out small. □

Hillel Segal is president of the Association of Computer Users, a nonprofit association with members all over the U.S., Canada and several other foreign countries.

One of the association's key activities is the publication of its Benchmark Reports. Each month a new report is produced covering another computer system.

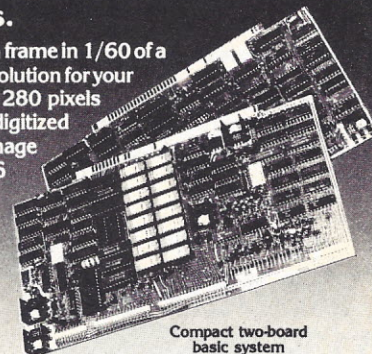
In addition, ACU publishes seven bimonthly newsletters for users of small computers, midi computers, large computers, time-sharing systems, distributed processing systems, word processing systems and home and hobbyist computers.

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The original 256-color imaging system with high resolution video FRAME GRABBER for the S-100 bus.

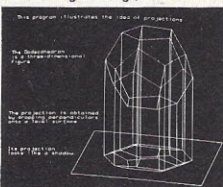
Capture and digitize a video frame in 1/60 of a second. Select the best resolution for your application, from 256 to 1280 pixels per TV line. Display your digitized or computer processed image with 256 gray levels or 256 colors on standard B&W, NTSC or RGB color TV monitors.



Compact two-board basic system



240x256 Digitized image, 16 levels



480x512 Computer-generated

Features:

- Highest possible quality 480x512x8 digital video image presently available on the market
- Input capability from TV camera or other sources
- Variety of synchronization choices
- 2 selectable video A/D conversion circuits
- Choice of 1, 2, 4, 8, 16 or 32 bits per pixel
- 32K-byte image memory on the basic system
- 32, 64, 128 & 256K byte system capacity
- Lightpen input
- Photographic trigger control input
- Software selectable system parameters
- Interfaces for TRS-80 and other processors
- Comprehensive line of accessories, monitors and support software

SEND FOR FREE CATALOG



DIGITAL GRAPHIC SYSTEMS

441 California Ave., Palo Alto, CA 94306 415/494-6088

CIRCLE INQUIRY NO. 23

\$360M IN WP/DP SALES BY OFFICE MACHINE DEALERS BY 1983

The role that Office Machine Dealers play in selling word processing/data processing today and tomorrow is the subject of a major report from Strategic Business Services, Inc. The report provides insights into the OMDs requirements for success in terms of capital requirements, personnel, training, support and products. Examined are OMDs who expect fully 25% of their total 1980 revenues to result from WP/DP sales. Vendors' views are also provided from companies using OMDs in their distribution strategies.

Major sections of the study are devoted to: (1) profits and margins; (2) requirements for initiation into and success in selling WP/DP; (3) the OMD as a user of DP; and (4) case studies of OMDs' actual experiences with WP/DP sales. Actual dealer, service, territory exclusivity and goal agreements are included for reference and are directly usable for setting up dealership arrangements.

For immediate delivery of **OFFICE MACHINE DEALERS: USERS AND VENDORS OF COMPUTERS**, send us your order and check for \$950.00. Detailed literature and Table of Contents available on request.

Strategic Business Services, Inc.

4320 Stevens Creek Blvd., Suite 215 • San Jose, CA 95129
Telephone (408) 243-8121 • Cable: STRATEGIC

CIRCLE INQUIRY NO. 97

INTERFACE AGE 57

S-100 HEADQUARTERS

2114-3L
4096 BIT (1024x4) 300ns
LOW POWER STATIC RAM

8/\$34⁰⁰
100 + \$3⁵⁰

5257-3L
(TMS 4044)
4096x1 300ns
LOW POWER STATIC RAM

8/\$50⁰⁰
100 pcs. + \$4⁷⁵

2708
450ns 8K
EPROM

\$8⁵⁰ each
or 8/\$54⁰⁰

2716
450ns 5 Volt only
16 K EPROM

\$12⁹⁵ each
or 10/\$100⁰⁰

MODEM SALE

\$139.00

THE STAR
MODEM
from LIVERMORE

FEATURE
FITS GTE HANDSETS!

2 YEAR WARRANTY

EXCLUSIVE ACOUSTIC CHAMBERS

The exclusive triple seal of Livermore's new flat mounted cups locks the handset into the acoustic chamber yielding superior acoustic isolation and mechanical cushioning. Designed to adapt to most common handsets used throughout the world, the STAR offers the utmost in flexibility and transmission reliability.

Specifications:

- Data Rate: 0 to 300 baud
- Compatibility: Bell 103 and 113; CCITT
- Frequency Stability: ± 0.3 percent. Crystal controlled
- Receiver Sensitivity: -50 dBm ON, -53 dBm OFF
- Modulation: Frequency shift keyed (FSK)
- Carrier Detect Delay: 1.2 seconds ON; 120 msec OFF
- EIA Terminal Interface: Compatible with RS 232 specifications
- Teletype Interface: 20 milliamperes current loop
- Optional Interfaces: IEEE 488; TTL; TTY 43
- International (CCITT) frequencies available
- Switches: Originate/Off/Answer; Full Duplex/Test/Half Duplex
- Indicators: Transmit Data, Receive Data, Carrier Ready, Test
- Power: Supplied by 24 VAC/150 MA UL/CSA listed wall-mount transformer. Input 115 VAC, 2.5 watts. (A 220 VAC, 50 Hz adaptor is available upon request.)
- Dimensions: 10" x 4" x 2"
- Weight: 1.74 lbs. (3 lbs. shipping weight including AC adaptor.)
- Warranty: Two years on parts and labor, excluding the AC adaptor which carries the manufacturer's warranty

Part No.	Description	List Price	SALE PRICE
LIV-STAR	RS232, TTL Modem	\$199.00	\$139.00
LIV-STAR20M	RS232, 20MA Current Loop	\$199.00	\$139.00
LIV-STAR-V21	CCITT European Standard	\$229.00	\$209.00
LIV-IEEE	IEEE 488 Standard	\$395.00	\$288.00
LIV-IEEE-V21	IEEE 488, CCITT Standard	\$465.00	\$388.00

CABLES

Part No.	Description	Price
CND-RS232BF	RS232 8 Cond 8 ft.	\$19.95
LIV-I21 IEEE	to IEEE 2 Meter	\$59.95
LIV-I2PET IEEE	to Pet 2 Meter	\$59.95

RS232 and "D" SUB-MINIATURE CONNECTORS

PART NO.	DESCRIPTION	1-9	10-24	25-99
CND-DE9P	9 PIN MALE	\$2.10	\$1.90	\$1.70
CND-DE9S	9 PIN FEMALE	\$2.70	\$2.40	\$2.10
CND-DE9C	9 PIN COVER	\$1.50	\$1.25	\$1.10
CND-DA15P	15 PIN MALE	\$2.75	\$2.45	\$2.15
CND-DA15S	15 PIN FEMALE	\$3.95	\$3.60	\$3.20
CND-DA15C	15 PIN COVER	\$1.50	\$1.30	\$1.10
CND-DB25P	25 PIN MALE	\$3.50	\$3.25	\$3.00
CND-DB25S	25 PIN FEMALE	\$4.60	\$4.35	\$4.20
CND-DB51212	1 PC. GREY HOOD	\$1.60	\$1.45	\$1.30
CND-P25H	2 PC. GREY HOOD	\$1.50	\$1.25	\$1.10
CND-DB51226	2 PC. BLACK HOOD	\$1.90	\$1.65	\$1.45
CND-DC37P	37 PIN MALE	\$5.80	\$5.10	\$4.45
CND-DC37S	37 PIN FEMALE	\$8.70	\$7.70	\$6.70
CND-DC37C	37 PIN COVER	\$1.80	\$1.55	\$1.30
CND-DO50P	50 PIN MALE	\$8.75	\$7.75	\$6.70
CND-DO50S	50 PIN FEMALE	\$11.65	\$10.25	\$8.90
CND-DO50C	50 PIN COVER	\$2.00	\$1.80	\$1.60
CND-D20418	HARDWARE SET 2 PR.	\$1.00	\$0.80	\$0.70
CND-RS232BF	RS232 DB25P, EIA CLASS 1 CABLE 8 CON 8 FT.	\$19.95	\$17.95	\$15.95
CND-5730360	CENT. 700 SERIES PRINTER CONNECTOR	\$9.00	\$7.50	\$6.00

S-100 PRODUCTS

California Computer Systems

16K CCS 2016 STATIC RAM
ASSEMBLED & TESTED—100% BURN IN

All boards tested at 4 MHz for Z80

		List Price	SALE
CCS-2016BA	450ns 2MHz	\$349.95	\$259.00
CCS-2016BB	300ns 4MHz	\$389.95	\$279.00
CCS-2016BX	Bare Board only		\$29.95

32K CCS 2032 STATIC RAM

	List Price	SALE
CCS2032A	\$710.00	\$549.00

Static S-100 Memory

32K ECONORAM XX

	List Price	Our Price
GBT164U16	16K RAM Unkit	\$319.00
GBT164A16	16K RAM A&T	\$359.00
GBT164C16	16K RAM CSC	\$439.00
GBT164U24	24K RAM Unkit	\$429.00
GBT164A24	24K RAM A&T	\$485.00
GBT164C24	24K RAM CSC	\$579.00
GBT164U32	32K RAM Unkit	\$559.00
GBT164A32	32K RAM A&T	\$599.00
GBT164C32	32K RAM CSC	\$720.00

16K ECONORAM XIV

	List Price	Our Price
GBT143U	Unkit	\$279.00
GBT143A	A&T	\$299.00
GBT143C	CSC	\$399.00

SPECTRUM

S-100 COLOR GRAPHICS BOARD

	List Price	Our Price
GBT144U	UNKIT	\$299.00
GBT144A	A&T	\$349.00
GBT144C	CSC	\$399.00

GBT2D	SUBLOGIC UNIVERSAL GRAPHICS INTERPRETER SOFTWARE	\$35.00
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PROCESSORS

GBT161 8085 CPU BOARD
GBT1612 8085/8088 CPU BOARD
BOARD WITH 8085 ONLY

	List Price	Our Price
GBT161U	Unkit	\$235.00
GBT161A	Assembled & Tested	\$325.00
GBT161C	200 hr. Burn in Test	\$425.00

BOARD WITH 8085 & 8088

	List Price	Our Price
GBT1612U	Unkit	\$295.00
GBT1612A	Assem. & Tested	\$425.00
GBT1612C	200 hr. Burn in Test	\$525.00

CCS-2810 Z80 CPU

2/4 MHZ CPU W/Serial I/O

	List Price	SALE
CCS-2810	A&T	\$300.00
		\$275.00

ORDER TOLL FREE
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except CA., AK., HI., CALL
(213) 894-8171



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Terms: Visa, MC, BAC, Check, Money Order, U.S. Funds Only. CA residents add 6% sales tax. Minimum order \$15.00 Prepaid U.S. orders less than \$75.00 include 6% shipping and handling. MINIMUM \$2.50. Excess refunded. Just in case ... please include your phone no. Prices subject to change without notice. We will do our best to maintain prices thru January 1981.

*SOCKET and CONNECTOR prices based on GOLD, not exceeding \$700 per cz.

*Sale Prices are for prepaid orders only credit card orders will be charged appropriate freight

TRS-80/APPLE

MEMORY EXPANSION KITS

4116's RAMS

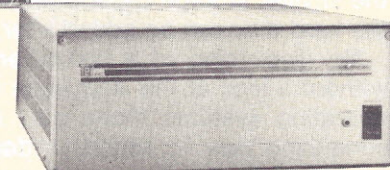
100% GUARANTEED
1,000's SETS SOLD
from Leading Manufacturers
(16Kx1 200/250ns)
8 for \$36⁰⁰

ADD \$3.00 FOR PROGRAMMING JUMPERS
FOR TRS-80 KEYBOARD

4116's 100 pcs & UP \$4.20 each
1000 pcs & UP \$3.80 each



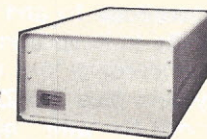
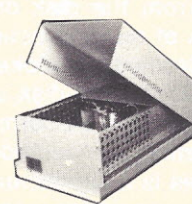
MAINFRAMES



From the power supply through the sturdy chassis, TEI constructs and assembles each mainframe with great care. Every TEI mainframe utilizes a constant voltage transformer (CVT) which delivers clean, regulated power at the proper level, reducing the heat in the computer cards. The output voltage on the transformer remains nearly even with the input voltage varying from approximately 85V to 140V. This means the mainframe will never notice voltage variations or even a brownout. It also provides 100 dB noise rejection to protect the computer from voltage spikes and line noise.

S-100 MAINFRAMES	LIST PRICE	OUR PRICE
TEI-MCS 112	12 Slot Desk	\$685.00
TEI-MCS 122	22 Slot Desk	\$845.00
TEI-RM 12	12 Slot Rackmount	\$800.00
TEI-RM 22	22 Slot Rackmount	\$945.00
Shipping Weight:	On 12 Slot Mainframes	35 Lbs.
	On 22 Slot Mainframes	50 Lbs.

Include Money for Shipping on all Mainframes



CALIFORNIA

Computer Systems

- S-100 compatible • Industrial/commercial quality construction • Flip-top cover • Excellent cooling capability • 12 slot capability (uses model 2501A) • Input 105, 115, or 125 VAC • Output + 8 VDC20A, + - 16 VDC 4A • Active termination of all bus lines • Fan and circuit breaker included • Rugged construction.

	LIST PRICE	SALE
CCS-200A	Assembled & Tested 35 lbs.	\$399.95
CCS-2200AK	Kit 35 lbs.	\$349.95
		\$329.00

S-100 GODBOUNT

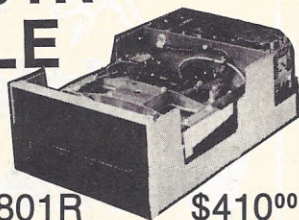
MOTHERBOARDS

	LIST PRICE	OUR PRICE
GBT-153U	UNKIT 6 SLOT	\$89.00
GBT-153A	A&T 6 SLOT	\$119.00
GBT-154U	UNKIT 12 SLOT	\$129.00
GBT-154A	A&T 12 SLOT	\$149.00
GBT-155U	UNKIT 20 SLOT	\$174.00
GBT-155A	A&T 20 SLOT	\$189.00



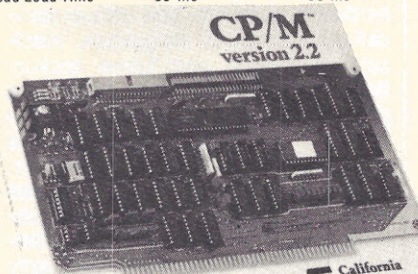
DISK DRIVES, etc.

Shugart SA801R SALE



SHU-SA801R \$410⁰⁰
2 OR MORE **\$395⁰⁰ ea.**

Capacity	Single Density	Double Density
Unformatted	3.2 megabits	6.4 megabits
Per Disk	41.7 kilobits	83.4 kilobits
IBM Format		
Per Disk	2.0 megabits	n/a
Per Track	26.6 kilobits	n/a
Transfer Rate	250 kilobits/sec.	500 kilobits/sec.
Latency (average)	83 ms	83 ms
Access Time		
Track to Track	8 ms	8 ms
Average	260 ms	260 ms
Setting Time	8 ms	8 ms
Head Load Time	35 ms	35 ms



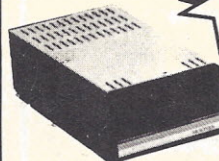
California Computer Systems
CCS2422
FLOPPY DISK CONTROLLER
WITH CP/M VERSION 2.2 **SALE \$375.00**

IEEE S-100 COMPATIBLE SINGLE/DOUBLE DENSITY
5 1/4" 8" DISK DRIVES
SINGLE/DOUBLE HEADED
ASSEMBLED & TESTED
LIST \$400.00



Part No.	Sectoring	Application	Box of 10
VRB-MD 525-01	Soft Sector	TRS-80 Apple	\$29.95
VRB-MD 525-10	Hard 10 Sector	North Star	\$29.95
VRB-MD 525-16	Hard 16 Sector	Micropolis	\$29.95
VRB-MD 577-01	Soft Sector	77 Track Cert	\$48.00
VRB-MD 577-16	Hard 16 Sector	77 Track Cert	\$48.00
VRB-FD32-1000	Hard Sector	Shugart 801R	\$37.00
VRB-FD34-1000	Soft Sector	IBM 3740	\$37.00

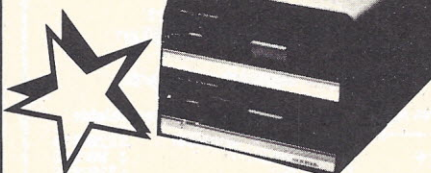
MICROPOLIS™



MCP1027M1

35 TRACK ADD-ON
FOR THE TRS-80
LIST \$545.00

SALE \$279⁰⁰



MISCROPOLIS OVERSTOCK LIST

MODEL	DESCRIPTION	LIST	SALE PRICE
S-100 SUB-SYSTEMS			
MCP-1053-2	630 KB DUAL	\$1895.00	\$995.00
MCP-1043-2	315 KB SINGLE	\$1145.00	\$695.00
MCP-1041-2	315 KB SINGLE, NO PS	\$1045.00	\$639.00
MCP-1042-1	143 KB SINGLE	\$795.00	\$625.00
MCP-1041-1	143-KB SINGLE, NO PS	\$695.00	\$595.00

COMPLETE W/S-100 CONTROLLER, CABLES,
MANUALS AND MICROPOLIS MDOS AND BASIC
ADD-ON DRIVES

MCP-1033-2	630 KB DUAL	\$1395.00	\$895.00
MCP-1023-2	315 KB SINGLE	\$645.00	\$495.00
MCP-1021-2	315 KB SINGLE, NO PS	\$545.00	\$475.00
MCP-1002-1	143 KB SINGLE	\$545.00	\$375.00
MCP-1021-1	143 KB SINGLE, NO PS	\$445.00	\$360.00

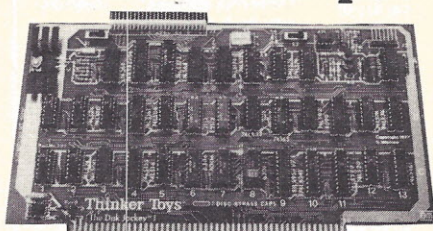
REQUIRES ACCESSORY ADD-ON CABLES

TRS-80® DISK DRIVES			
MCP-1027-1	35 TRACK SINGLE	\$545.00	\$299.95
MCP-1037-1	35 TRACK DUAL	\$1195.00	\$695.00
MCP-1027-2	77 TRACK SINGLE	\$645.00	\$439.00
MCP-1037-2	77 TRACK DUAL	\$1395.00	\$795.00

ACCESSORIES

APP 395M	NEW DOS/80 TRS-80® 35 thru 77 TRACK OPERATING SYSTEM	SUPPLIED 35 TRACK \$149.00	ON 77 TRACK \$159.00
PR1-34CEEE-2	Two Drive Data Cable		\$29.95
PR1-34CEEE-4	Four Drive Data Cable		\$39.95

Thinker Toys™



DISK JOCKEY I
FLOPPY DISK CONTROLLER-SINGLE DENSITY

THT-DJ1K	KIT	LIST PRICE	SALE
THT-DJ1A	A&T	\$229.00	\$179.00

DISK JOCKEY 2D
FLOPPY DISK CONTROLLER-DOUBLE DENSITY

THT-DJ2DK	KIT	LIST PRICE	SALE
THT-DJ2DA	A&T	\$429.00	\$409.00

Thinker Toys™



DISCUS/2D™
DOUBLE DENSITY DISK SYSTEM

Why not go all the way to the professional/industrial standard of 600K byte/side disk memory with your S-100 system? The new DISCUS/2D™ full-size, double-density floppy disk system is actually less expensive than many mini-floppy systems.

And Thinker Toys™ hasn't just made full-size, double-density disk memory affordable...we've made it more functional.

Thinker Toys™ has developed BASIC-V!™ a virtual disk BASIC that lets you address all 600K bytes (expandable to 1 megabyte) as if were main memory. The data format is soft-sectored and compatible with IBM's new System 34. And DISCUS/2D™ accepts both single-density and double-density disks for complete flexibility in data storage.

And DISCUS/2D™ is even more attractive because it's priced and delivered as a truly complete system. It's complete with all hardware. It's complete with all necessary software. And it's completely assembled, tested and warranted.

Specifications:

- CP/M V2.2 standard
- Plug compatible with Shugart, Remex and Siemens single- or double-sided drives
- Double/single-density capability utilizing MFM and FM data formats
- Western Digital 1791 LSI floppy disk controller chip
- Uses 2K of S-100 address space:
 - 1K PROM with built-in disk drive and I/O utility subroutines incorporating memory mapped I/O
 - 1K 2114-3L 300 ns access time RAM for disk data offering and general purpose use
- Starting address of memory space is 340:000 (E000 hex) for compatibility with other popular ROM based systems
- Phase-locked data separator and crystal controlled disk data write precompensation capability to insure the highest standards of data integrity in double density mode.
- Compatible with all 2 MHz and 4 MHz systems which conform with the proposed IEEE standard for the S-100 bus
- 1602 UART with crystal-controlled baud-rate generator
- Sixteen switch selectable baud rates from 50 to 19,200 bits/second
- TTY current loop and industry standard RS232C serial interface
- Power-on jump circuitry for automatic bootstrap loading from the disk drive
- Power supply requirements: + 8V @ 1200 ma; + 16V @ 150 ma; -16V @ 70 ma.

THT-D2DS Single Drive List Price \$1199.00 SALE \$990.00

THT-D2DD Double Drive List Price \$1994.00 SALE \$1649.00

THT-D22S Single Drive List Price \$1545.00 SALE \$1298.00

THT-D22D Double Drive List Price \$2740.00 SALE \$2295.00

DISCUS 1 FULL-SIZE, SINGLE-DENSITY DISK MEMORY SYSTEM

Specifications:

Data Specifications and Formats

- 250,000 byte capacity per standard 8" floppy diskette
- Soft-sectored IBM-compatible format: 77 tracks/26 sectors per track/128 bytes per sector
- Includes Disk/ATE™ disk operating system with integral monitor, assembler and text editor & BASIC-V advanced virtual disk BASIC capable of addressing up to 1 megabyte
- Software customized for SOL and Exidy available
- Patches for CP/M* included
- Optional CP/M* Microsoft BASIC, and FORTRAN available.

THT-D1S Single Drive	List Price	Our Price
THT-D1D Dual Drive	\$995.00	\$950.00
	\$1790.00	\$1595.00

DISCUS HD 26 MEGABYTES

THT-M26S Subsystem	List Price	SALE
THT-M26A Add-on hard disk drive	\$4995.00	\$4095.00
THT-M26HDC Hard disk controller	\$4995.00	\$3995.00
Shipping Weight: THT-M26S&A		50 lbs.
Shipping Weight: THT-M26HDC		3 lbs.

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Terms: Visa, MC, BAC, Check, Money Order, U.S. Funds Only. CA residents add 6% sales tax. Minimum order \$15.00 Prepaid U.S. orders less than \$75.00 include 5% shipping and handling. MINIMUM \$2.50. Excess refunded. Just in case ... please include your phone no. Prices subject to change without notice. We will do our best to maintain prices thru January 1981.

*SOCKET and CONNECTOR prices based on GOLD, not exceeding \$700 per oz.

*Sale Prices are for prepaid orders only credit card orders will be charged appropriate freight

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with software purchase—
choice of:
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Ad#9

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Also within 30 days after making a purchase at Discount, if you should find a lower advertised price on what you bought, just show us that ad. We'll refund the difference. It's that simple.

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WITH
MANUAL /
MANUAL
ONLY

CP/M

OSBORNE †	
General Ledger#	\$ 59/\$20
Acct Rec/Acct Pay#	\$ 59/\$20
Payroll w/Cost#	\$ 59/\$20
Buy 2 get 1 free	\$118/\$57
All 3 & CBASIC-2	\$199/\$71

DIGITAL RESEARCH*

CP/M* 2.2 Northstar	\$149/\$25
CP/M* 2.2 Micropolis	\$169/\$25
✓ CP/M* 2.2 Durango	
F-85	\$169/\$25
CP/M* 2.2 Cromemco	\$189/\$25
CP/M* (other versions)	Call
✓ PL/I-80	\$459/\$35
Mac	\$ 85/\$15
Sid	\$ 65/\$15
Z-Sid	\$ 95/\$15
Tex	\$ 70/\$15
DeSpool	\$ 45/\$10

MICROSOFT

Basic-80	\$294/\$30
Basic Compiler	\$334/\$30
Fortran-80	\$384/\$30
Cobol-80	\$574/\$30
Macro-80	\$144/\$20
Edit-80	\$ 84/\$20
MuSimp/MuMath	\$224/\$25
MuLisp-79	\$174/\$20

MICRO DATA BASE SYSTEMS

HDBS	\$250/\$40
MDBS	\$750/\$40
Other	Call

S.O.F.T.W.A.R.E.

MicroTax*†	
Federal individual	\$749/\$50
Federal corporate	\$249/\$25
State individual	\$249/\$25

TC&S

✓ General Ledger	\$ 79/\$25
✓ Acct Receivable	\$ 79/\$25
✓ Acct Payable	\$ 79/\$25
✓ Payroll	\$ 79/\$25
✓ All 4	\$269/\$99

SUPERSOFT

Forth (8080 or Z80)	\$129/\$25
Diagnostic I	\$ 49/\$20
Other disk software	less 10%

SOFTWARE WORKS

Adapt	\$ 69/ na
Ratfor	\$ 86/ na

COMPUTER PATHWAYS

Pearl (level 1)#	\$ 99/\$25
Pearl (level 2)#	\$299/\$25
Pearl (level 3)#	\$549/\$25

COMPLETE BUSINESS SYSTEMS†

✓ Creator	\$269/\$25
✓ Reporter	\$169/\$20
✓ Both	\$399/\$45

CP/M users: specify disk systems and formats. Most formats available.

T.I.M. DBMS†‡
Fantastic/Easy to
use Special \$299

MICROPRO

WordStar	\$324/\$40
✓ Mail/Merge	\$114/\$25
WordStar/Mail-Merge	\$434/\$65
DataStar	\$279/\$35
Word-Master	\$119/\$25
SuperSort I	\$199/\$25
SuperSort II	\$169/\$25
SuperSort III	\$119/\$25

PEACHTREE*†‡

General Ledger	\$449/\$40
Acct Receivable	\$449/\$40
Acct Payable	\$449/\$40
Payroll	\$449/\$40
Inventory	\$449/\$40
Property Mgt	\$899/\$40
C.P.A. Client Write-up	\$899/\$40
Mailing Address	\$349/\$40

STRUCTURED SYSTEMS

General Ledger#	\$747/\$40
Acct Receivable#	\$747/\$40
Acct Payable#	\$747/\$40
Payroll#	\$747/\$40
Inventory Control#	\$447/\$40
Analyst#	\$197/\$20
Letterlight#	\$167/\$20
NAD#	\$ 87/\$20
QSORT	\$ 87/\$20

GRAHAM-DORIAN†

General Ledger#	\$693/\$40
Acct Receivable#	\$693/\$40
Acct Payable#	\$693/\$40
Job Costing#	\$693/\$40
Payroll#	\$493/\$40
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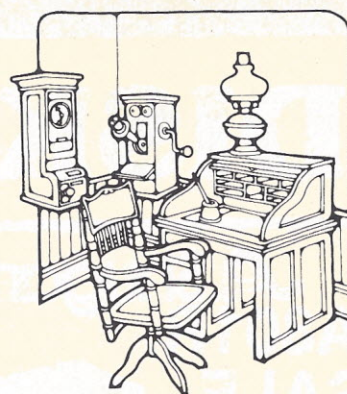
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Articles Wanted...

INTERFACE AGE is seeking articles on computerized communications for the July issue. Articles on terminal-to-terminal relay, networking, databases, and communications hardware (printers, couplers, modems, etc.) will be included. Articles intended for the July issue should be received no later than March 16 for consideration.

Other subjects being sought for 1981 coverage include: business hardware, software, and unique applications, computer languages, medical, educational and home applications, peripherals and interfacing products, mini systems in the business field, word processors, and the equipment rental/leasing industry.

The payment rate for articles ranges from \$20 to \$50 per published page. Pieces describing company projects or products will carry the company byline, but no payment is offered. Submittals should include an abstract, outline and stamped return envelope.

Manuscripts should be typed, double spaced with one-inch margins. Minimum length is four pages, unless programs are included. Photos should be numbered and have a brief description attached. Tables, listings, etc. should be on separate pages and each should have a caption. Computer listings should be printed using a new ribbon to assure good reproduction. Authors are requested to submit a statement of their background and expertise.

The publisher assumes no responsibility for artwork, photos or manuscripts. No acknowledgement is made unless accompanied with a stamped return envelope.

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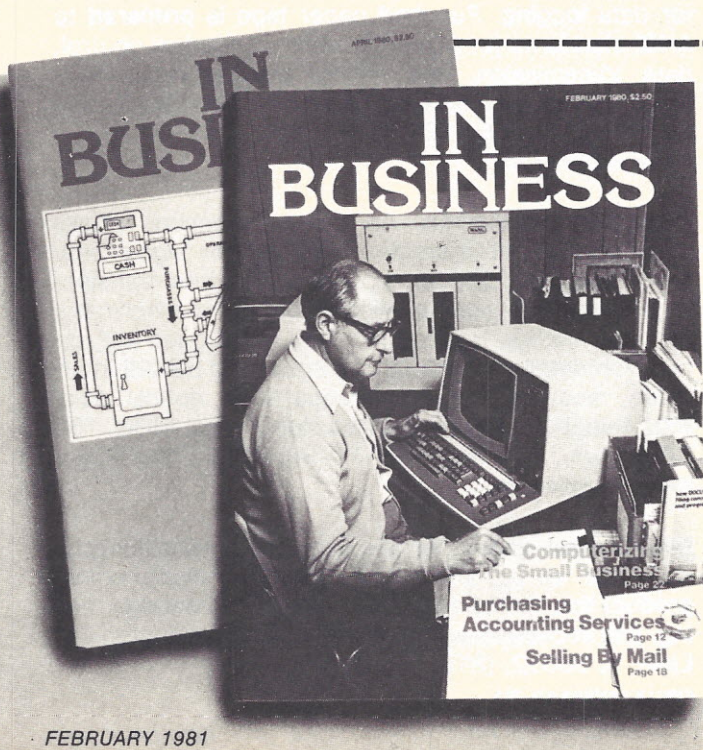
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CIRCLE INQUIRY NO. 34

INTERFACE AGE 61



Free Literature



Capacitor catalog. A 20-page manual describes line of all-tantalum electrolytic capacitors for avionics, aerospace, and other high reliability applications. David Hayward, Plessey Capacitors, 5334 Sterling Center Dr., Westlake Village, CA 91361, (213) 889-4120, TWX 910-494-4779.

CIRCLE INQUIRY NO. 308

Dual transistors. A 52-page catalog lists all of the detailed specs for over 450 monolithic matched dual transistors and dual J-FETs. Included are data and technical information such as electrical characteristics, packaging, chip sizes, and bonding pads. Micro Powers Systems, 3100 Alfred St., Santa Clara, CA 95050, (408) 247-5350, Telex 910-338-0154.

CIRCLE INQUIRY NO. 309

Video display. Brochure describes Lear Siegler's ADM-42 Ergonomic terminal video display and ADM-31 intermediate terminal video display. The publication details the types of modifications available and offers brief instructions for implementing the changes. Lear Siegler, Inc., 714 N. Brookhurst St., Anaheim, CA 92803, (800) 854-3805.

CIRCLE INQUIRY NO. 310

Course information. A 40-page catalog describes educational programs and test instruments for schools, industry, government, and self-instruction. Details on 17 courses including electronics, microprocessors, automotive, and computer programming, for self-instruction and college level study are included. Also listed are product descriptions and specifications on more than 40 test instruments. Heath Co., Dept. 350-370, Benton Harbor, MI 49022.

CIRCLE INQUIRY NO. 311

Short distance. A brochure, The Shortest Distance Between Two Points, details Xodiac software's modular design; its adherence to CCITT Recommendation X.25 international protocol; and its ability to communicate via high-speed local links, public data networks, and common carriers. Publication #012-915. Communications Services, M.S. C-228, Data General Corp., 4400 Computer Dr., Westboro, MA 01581.

CIRCLE INQUIRY NO. 312

Digitizers for OEMs. A 6-page brochure gives specifications, applications, and principles of operation for 12 and 15" touch screen digitizers. TSD Display Products, 35 Orville Dr., Bohemia, NY 11716, (516) 589-6800, Telex 14-14659.

CIRCLE INQUIRY NO. 313

Supplies and accessories. Catalog lists over 300 items for minicomputer and small computer system end users. Among the products included are Memorex magnetic media, Write Line cabinets, and Moore Business forms. Robert D. Leigh, Challenge Computer Supplies, Box 3269, Redwood City, CA 94064, (415) 365-8105.

CIRCLE INQUIRY NO. 314

Circuit equipment. A 48-page catalog describes an extensive line of printed circuit connectors and accessories. Included are dip-solder, wire-wrap and round-tail connectors, and the Erik series of selectively-plated pc edgeboard connectors. Viking Connectors, 21001 Nordhoff St., Chatsworth, CA 91311, (213) 341-4330.

CIRCLE INQUIRY NO. 315

Fiberoptics. Newsletter includes facts about: a functional demonstration of duplex fiberoptic data transmission; the nation's first 90 megabit/second fiberoptic telephone system; transmission of congressional proceedings over a fiberoptic video and audio system. Fiberoptics, Valtec Corp., 99 Hartwell St., West Boylston, MA 01583.

CIRCLE INQUIRY NO. 316

Push button data. A 72-page catalog details push buttons, key switches, rotary and slide switch equipment. Also featured is an option guide for quick selection, a statement of product warranty, a glossary of terms, and suggestions for switch cleaning procedures. ITT Schadow, 8081 Wallace Rd., Eden Prairie, MN 55344, (612) 934-4400.

CIRCLE INQUIRY NO. 317

'How To...' guide. Brochure focuses on the evolution, current status and future potential of portable processing. 'How to Carry your Business into the 80s' is filled with factual examples of how portable processing is answering the unique needs of practical business, financial, industrial and government applications. Computer Devices, 25 N. Ave., Box 421, Burlington, MA 01803.

CIRCLE INQUIRY NO. 318

Printers and tape. Catalog lists equipment for stand-alone and OEM printers and punched paper tape. Printers are numeric/limited alpha and are used largely for data logging. Punched paper tape is prepared to ANSI standards for computer entry, numerical control, data transmission, and PROM programmers. Addmaster Corp., 416 Junipero Serra Dr., San Gabriel, CA 91776, (213) 285-1121.

CIRCLE INQUIRY NO. 319

Interface protection. An 8-page brochure details complete line of protection devices for signal/data/telephone lines. The units protect lines from transient overvoltages caused by lightning, heavy machinery, elevator motors, generators. Also catalogued are application details for RS232C, RS423, and RS422 interfaces, modems, transformer couplings, optical isolators, telephone lines and video signal lines. MCG, 160 Brook Ave., Deer Park, NY 11729, (516) 586-5125.

CIRCLE INQUIRY NO. 320

Matrix wall chart. Poster lists basic specifications and data on Jet Flecs IDT insulation displacement product line, including cable connectors, headers, tooling, and accessories. Molex, Inc., 2222 Wellington Ct., Lisle, IL 60532, (312) 969-4550.

CIRCLE INQUIRY NO. 321

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CIRCLE INQUIRY NO. 42

Data screen terminals are described in a four-page brochure. The series 510/610 units include upper and lower case; conversational or buffered data communication capabilities at 110 through 9600 baud protected data fields; forward and back tab; and five video attributes. TEC, Inc., 2727 N. Fairview Ave., Tucson, AZ 85705.

CIRCLE INQUIRY NO. 322

Cam conversions are detailed in an illustrated brochure. The publication shows how to specify master, prototype and production cams for manufacture to highly critical tolerances by EDP-CPNC. Cam Technology, Inc., 10 Havens St., Elmsford, NY 10523.

CIRCLE INQUIRY NO. 323

Microcomputer books are listed in the spring catalog of Dillithium Press. Over 65 books are cataloged, as well as software for the TRS-80 level II and the 8K Pet. Dillithium Press, 30 NW 23rd Place, Portland, OR 97201.

CIRCLE INQUIRY NO. 324

TRS-80 printer interface is detailed in a five-page booklet. Instructions, schematic, parts list and software driver listing for connection to an RS-232 printer are included. Fobel Enterprises, Dept. I, 552 E. El Morado, Ontario, CA 91764.

CIRCLE INQUIRY NO. 325

Modular storage cabinets are listed in a 12-page brochure. Text, photographs, and line drawings show how modular units in plant departments save floor space, retrieval times, and protect parts and components from static or seismic damage. Stanley-Vidmar, Inc., 11 Grimes Rd., Allentown, PA 18103.

CIRCLE INQUIRY NO. 326

Video display terminal is described in a two-page illustrated data sheet. Soroc IQ 140 is a remote terminal with a 117-key detachable keyboard and 80 mini-switches. Soroc Technology, Inc. 165 Freedom Ave., Anaheim, CA 92801.

CIRCLE INQUIRY NO. 327

Peripheral controller handbook outlines hardware, software, and system considerations for the connection of disk and tape storage subsystems to DEC computers. Emulex Corp., 2001 E. Deere Ave., Santa Ana, CA 92705.

CIRCLE INQUIRY NO. 328

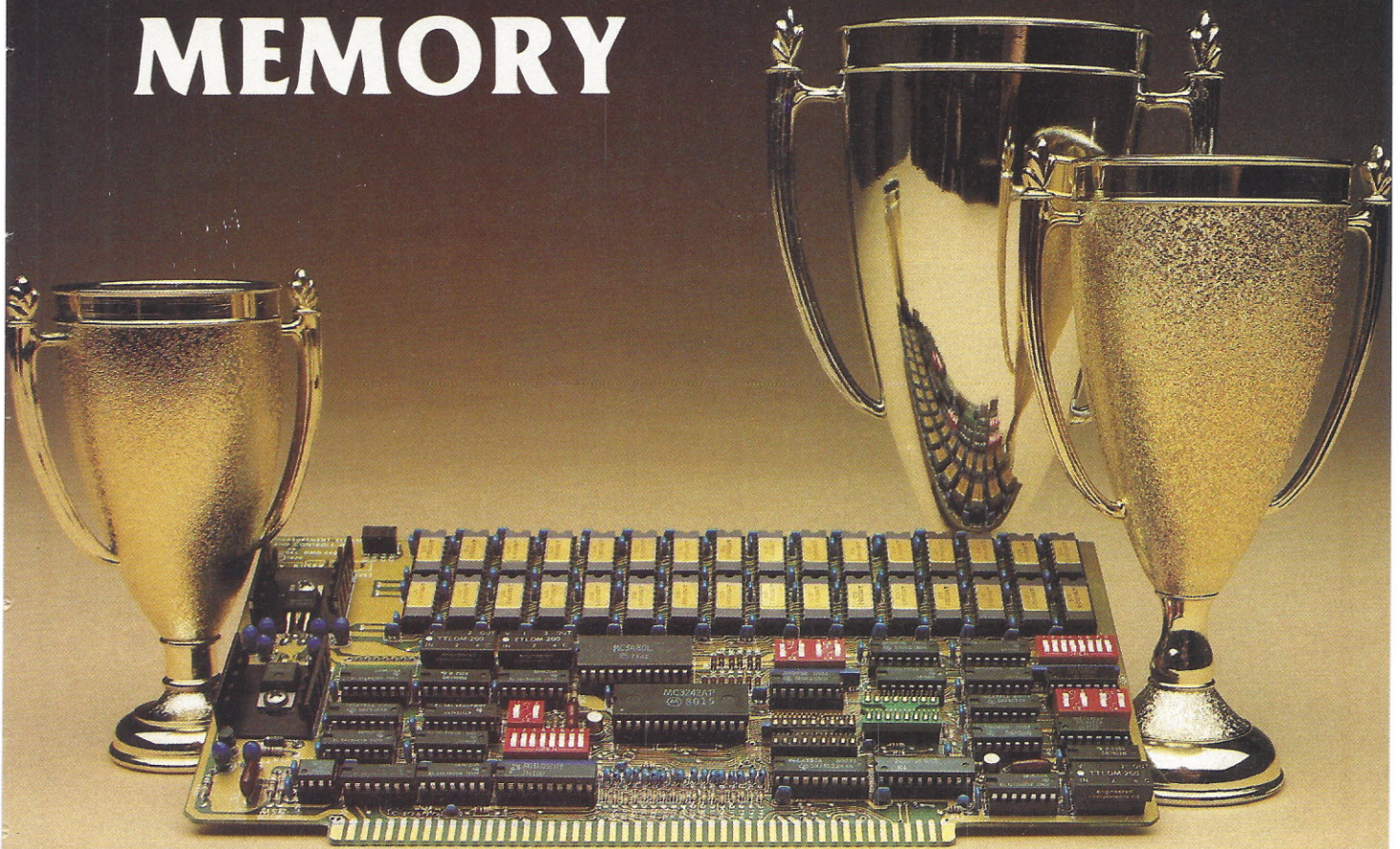
Computer map making is detailed in a lab-log catalog of Harvard University school of design. Supplementary special programs, cartographic data bases, and computer graphic publications are also included. Laboratory for Computer Graphics and Spatial Analysis, Graduate School of Design, Harvard University, 520 Gund Hall, Cambridge, MA 02138.

CIRCLE INQUIRY NO. 329

Switching power supplies are listed in catalog. Over 120 models of 40-150 W units are described, as well as details on the Univerter switching circuit. Etatech, Inc., 187-M W. Orangethorpe, Placentia, CA 92670.

CIRCLE INQUIRY NO. 330

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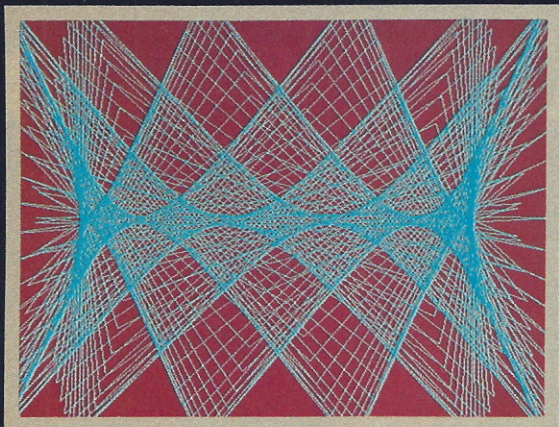
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Courtesy of Aydin Controls

COMPUTER GRAPHICS...

by Michael LocEFF

To the casual observer, "computer graphics" may hint of Madison Avenue sensationalism—a passing fad designed to sell more gadgets to an already gadget-saturated public. But the computer graphics movement did not shoot up overnight and the fuel that feeds it is not Madison Avenue hype. It has a rapidly growing list of users and applications that demand a more humanistic dialogue with the computer.

Applications range from cartoon animation and medical imaging systems to computer aided instruction and the design and simulation of space vehicles. Of the various technologies that make possible the generation of an image on a display screen, there are three employed in the majority of commercial applications: raster scan, direct view storage tube (DVST), and calligraphic (also known as stroke writer or vector refresh) display systems. Anyone wishing to use computer graphics should be aware of the strengths,

weaknesses and operating characteristics of each before acquiring such a system.

Regardless of the display technology used, a computer graphics display system consists of a number of essential components (figure 1). First, a means of input must exist such as an optical scanner, digitizing tablet, light pen or console. Second, a means of processing the image data once in the computer is necessary. This usually takes the form of a host CPU, but can be a separate, dedicated graphics processor.

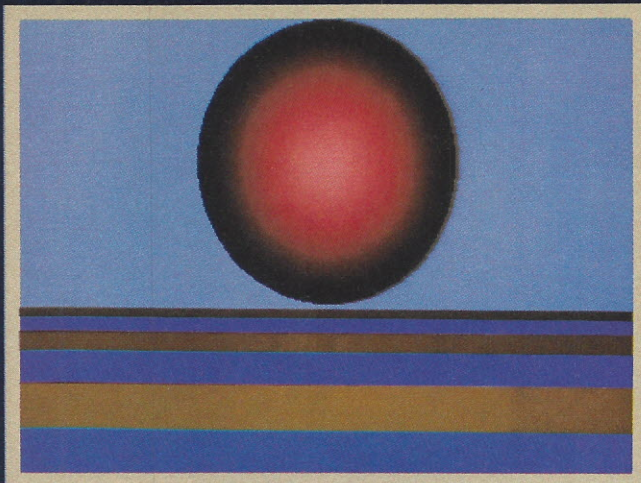
Third, a means of storing the image for refresh purposes must be provided. Here we are referring to an area where picture data can be buffered for ready access by the display device. In raster systems, this is called the frame buffer, while in calligraphic or DVST displays it's called a display list.

The fourth component is the graphics interface—the hardware that intervenes between computer and display. The graphics interface is respons-

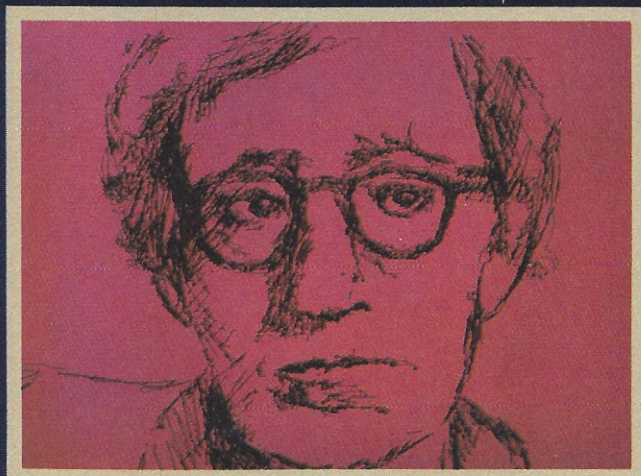


Micrographic of Picasso's Dreamer by Emily Reilly

**...a picture
is worth
1K words**

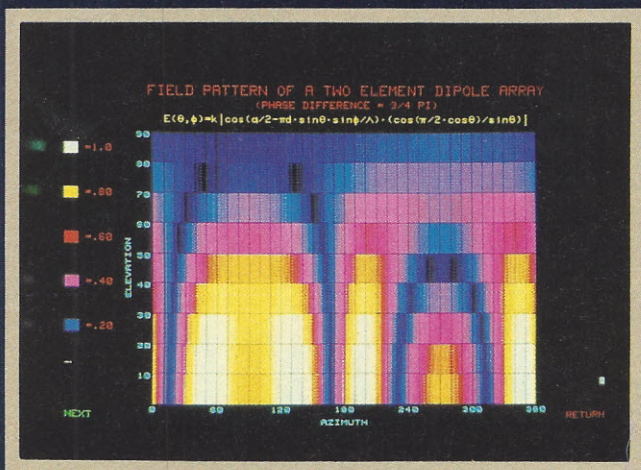


Adding multiple planes of image memory, hundreds of gray scales and colors can be displayed simultaneously.



Micrograph of Woody Allen by Emily Reilly

Using a data tablet and corresponding software, an artist can create an image that can be stored on disk and transmitted over phone lines.



Courtesy of Hewlett-Packard

Using raster scan color imaging in an engineering application.

ible for the conversion of digital information defining the image into analog signals required to drive the display.

The fifth and most obvious feature is the display itself. This determines the nature and configuration of the rest of the graphics hardware, and the nature of the display device determines the classification of the entire system as raster, calligraphic or DVST.

The development of a commercially feasible storage tube technology in the late '60s was the first introduction of computer graphics systems commercially. Before this there was Sketchpad developed at MIT by Dr. Ivan Sutherland. Sketchpad was the first demonstration of the true power that interactive computer graphics hold for the so-called 'man-machine' interface. Even today the sophisticated CAD/CAM (computer aided design and manufacturing) systems are mere extensions of the powerful Sketchpad concept.

DVST consists of three components: an electron writing gun cathode (with associated focusing and deflecting assemblies), a flood gun system and a phosphor-coated backplate (the screen). The DVST behaves like a CRT with extremely long-persistence phosphors. That is, when the electrons shooting from the writing gun strike the backplate, the affected phosphor retains a charge for hours after the 'hit'.

Thus, in order to draw a line segment from point A to point B, the writing gun is pointed at point A and activated as it is deflected toward point B. When the beam arrives at point B, the gun can be turned off or, if desired, further deflected to effect vector chaining. The writing gun is used only for tracing out charged patterns on the phosphor layer. Once the pattern is traced, the charged phosphor creates permanent image because of the flood gun electron bombardment.

With an understanding of storage tube technology, some of the main advantages and disadvantages of this kind of device can be understood. On the plus side, DVST affords extremely high resolution. This is accomplished by focusing the writing beam to a high degree of accuracy and localizing the phosphor charge so that adjacent phosphor regions are independent. Since the phosphor retains a charge for an indefinite period, there is no need to refresh the screen. This eliminates the flicker associated with some raster and stroke devices. The fact that the storage tube is an inherent memory eliminates the need for large amounts of buffer RAM.

Another plus for DVST is its capability to increase resolution by simply enlarging the screen. Sharpness is a function of the beam focus and phosphor selectivity, thus doubling the dimension results to four times the information storage. Specifications of 4096 by 4096 resolution are not uncommon to the DVST.

While useful as high resolution vector displays, the storage tube is essentially a one-color medium. Since color capability or gray scale imaging is not currently present in this technology, applications using image processing or shading are not well suited. In addition, the relatively low

Continued on page 124

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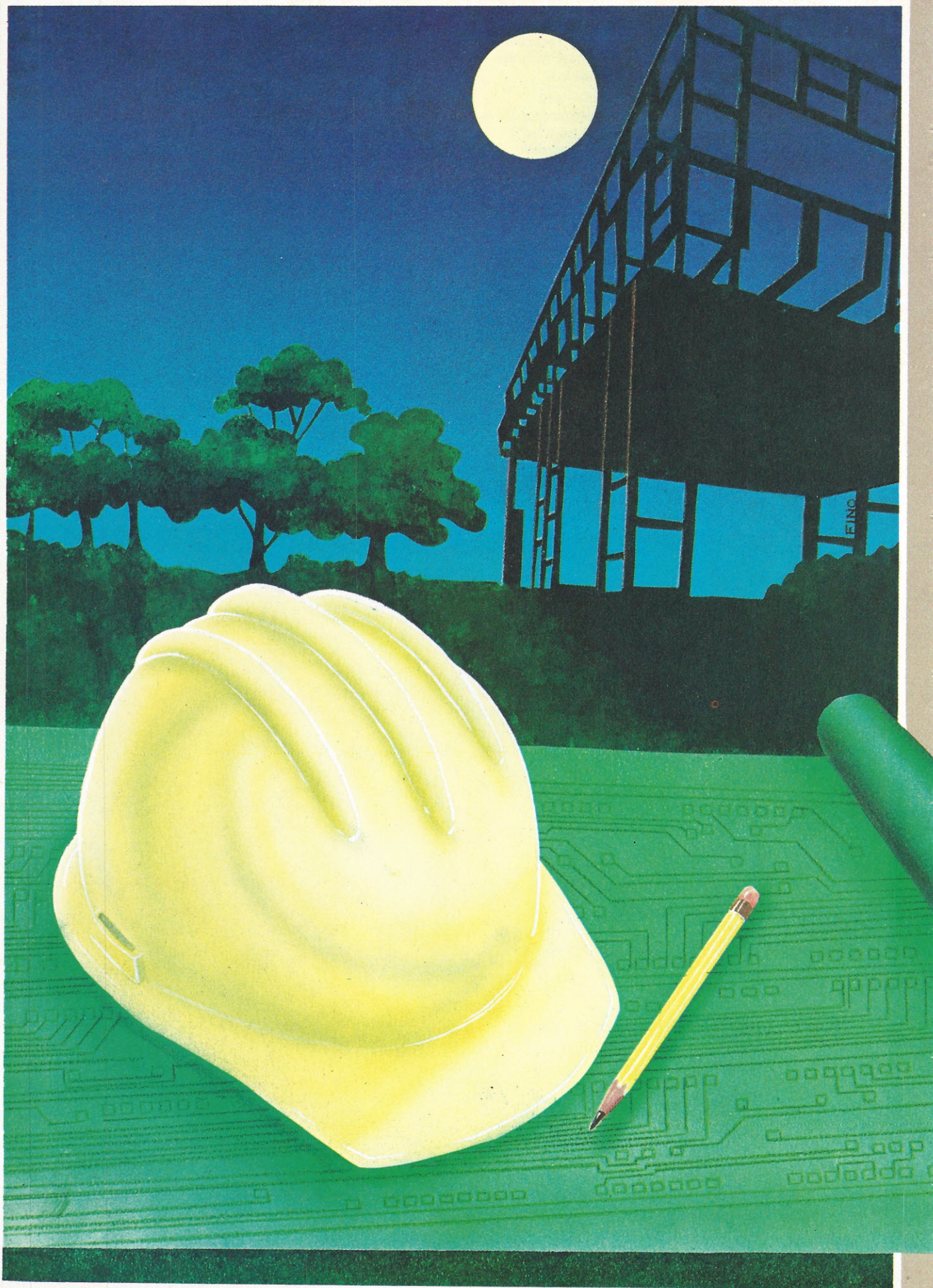
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Whether putting a man on the moon or merely building a house, it is necessary to monitor a project to ensure that it finishes on time and within its estimated cost. Management science has developed

many quantitative techniques toward this end. In fact, an entire branch called operations research is devoted specifically to logistics and similar problems.

Operations research was developed during World War II to maneuver armies and large contingents of machinery and supplies over vast distances. One is virtually useless without the other, particularly if they fail to arrive in the right place at the right time. Two widely accepted and used project management tools are critical path method (CPM) and performance evaluation and review technique (PERT).

The critical path method determines what activities in a project are "critical" in their total effect on project time, enabling a manager to better allocate resources to meet the target date at minimum cost. PERT is closely allied, however it allows the manager to specify activities of uncertain duration. PERT is widely credited with helping to shorten the Navy's Polaris missile program by two years.

Before introducing CPM and PERT, it is necessary to develop a method of diagramming the project. This is referred to as network construction and starts with a precedence table, which contains all activities, their expected duration and the required preparatory work.

Before constructing the network from the precedence table, terminology and rules must be understood. For instance, a circle is a "node" and indicates a specific moment in time. It may be thought of as a milestone marking the start or completion of an activity.

A directed arc connecting two nodes is called an "activity." An activity is a task to be performed within some finite length of time called the "duration."

For example, the single activity (A) of making breakfast may be diagrammed as shown in figure 1a. Node 1 represents an instant in time. Here it is the moment a person awakens. Node 2 marks the moment the person starts eating breakfast.

This method of constructing the network is referred to as the activity-on-arc (AOA) method.

Certain rules must also be obeyed. For instance, the network should have a unique starting event (a single origin node) and a unique completion event (a single terminal node). The nodes must be numbered so that the beginning node of an

activity has a smaller number than the terminal node. The Basic program checks this and requests the user to input the data gain if this rule is violated.

Another rule dictates that an activity must be represented by only one arc. Lastly, no two activities can

share both the same starting and completion node. Using an AOA network, this presents a problem since such situations often exist and must be diagrammed. To overcome this apparent dilemma, a "dummy" activity of 0 duration is used. Figure 1b illustrates a violation of the rule and 1c shows how the dummy activity (dotted arc) can be used in those cases where activities are conducted simultaneously. The dummy activity does not represent a time-consuming task, but merely satisfies network construction rules.

With rules and terminology understood, we are ready to construct a network. Our hypothetical project, which will serve as the model for the rest of this discussion, consists of constructing a widget of two printed boards A and B. Both boards need to be fabricated and stuffed with components; only board B needs calibration before it is placed in the widget and tested with board A.

Manpower and equipment resources will allow the boards to be fabricated simultaneously (in parallel). However, other resource constraints dictate that the stuffing operation cannot begin until both boards are complete. In addition, the boards must be stuffed one at a time (in series).

Table 1 shows the precedence table for the project in "technological order," which means that no activity appears until all of its predecessors have appeared.

Figure 2a represents the network developed from the table. Node 1 indicates the beginning of the project and node 6 marks its completion. The network consists of six real activities and one dummy activity inserted between nodes 2 and 3. This satisfies one rule of network construction: two activities cannot share the same start and end node.

The critical path method of analysis answers two questions: how long will the project take, and what activities directly effect its duration. While all concomitant activities bring the project to conclusion, certain activities require more time and are, therefore, more critical.

An examination of the network shows that the critical path (the one requiring the most time) are activities B, D, E, and F. The duration for this path is 100 minutes, and those are the activities to be closely monitored by the project manager.

Thus we have answered both of the original questions, namely what is the critical path and what is the project's duration. However, if a project consists of several hundred activities, such a cursory analysis would be impossible. In this event, a standard algorithm is used to answer the questions.

The algorithm used to find the critical path and its length is somewhat tedious, and is included only for completeness. Before starting, some simple concepts

must be understood.

Associated with each event (node) are two time values: the earliest starting time (EST), which is the earliest point in time at which an event can occur; and the latest finishing time (LFT), the last point in time at which an event can occur without delaying completion.

We begin the EST calculations at node 1. Since this is the origin event, it is assigned an EST value of 0. The EST for node 2 is 15 since activity A requires 15 minutes. The EST for node 3 may not be so easily understood since it requires a choice between activity A, which requires 15 minutes and activity B which requires 20 minutes.

As both the precedence table and the network clearly indicate, neither activity C nor D can begin until both activities A and B are completed. Therefore the EST for event 3 must be the longer duration, namely 20 minutes. The EST for event 4 is 40.

This value is obtained by merely adding the duration of the activity to the previous EST value. At event 5, we must pick the longer duration between 70 (EST event 3 plus duration of activity C) and 80 (EST event 4 plus duration of activity E). The earliest starting time for event 5 is 80. Lastly, the EST for event 6 is 100. All EST values are shown on the network in figure 2b.

The algorithm now requires us to examine the LFT of each activity. If the terminal event (node 6) finishes any later than 100 minutes after the beginning of the project, its entire duration is altered. The LFT of the completion event is by definition set equal to the EST of the terminal node, namely 100.

Starting from the terminal node, we proceed backwards to node 5. The LFT for node 5 is calculated by subtracting the activity's duration (20) from the LFT of the end node. This yields an LFT of 80 (100 - 20) for node 5. Calculating the LFT for node 4 is straightforward and performed in a similar manner. However, event 3 poses a problem since there are two activities, C and D, starting from this event.

We have to decide between an LFT of 20, which was calculated from activity D, and an LFT of 30, which was computed from activity C. The rule is simply to assign the smallest value to the event, in this case 20. Calculating the remaining LFT values is straightforward. Figure 2c shows all the LFTs in our example.

Armed with EST and LFT data, we can compute the "float" or "slack" time for each activity. The slack time is equal to the LFT of the end node, minus both the EST of the start node and the duration of the activ-

ity. For example, the float time for activity F is 0 (100 - 80 - 20). The float times for all activities are computed in a similar manner and are shown in figure 2d.

After this tedious calculating, we are ready to find the critical path. The activities with 0 slack time are critical since an increase in the duration of any of these activities will directly increase the project's total duration. By definition, the critical path is the path in which there is no slack time. In our case, activities B, D, E, and F lie on the critical path.

The project's duration is the length of this path, which is 100 minutes. Activities A and C have non-zero slack times and therefore can have slight time overruns without affecting the project. The project manager can schedule his resources accordingly. For example, when activity A is completed, he can transfer resources to activity B, shortening the duration of B, and thereby the project as a whole.

The Basic program shown in listing 1 analyzes both CPM and PERT problems. A run, based on the widget project, is shown in sample 1. To begin, the user specifies CPM or PERT (for the present, CPM). Next the user specifies the number of activities in the network, seven in our example. Note that dummy activities must be included.

All activity data is entered. This includes start node, end node, and duration. Note that the end node number must always be larger than the start node. The user will be requested to input the data again if this rule is violated. The input data is listed in a neat table to allow easy examination of the input data for correctness. If an error is discovered, the activity can be edited by specifying 'activity #'.

Assuming correct input, the program takes control and performs all the hard work. The results are threefold: the EST, LFT, and FLT times for each activity are given; the path length is displayed; and the critical path is given. The user can then either edit one or more activities and perform the analysis again, or stop the program. Being able to edit the data allows a project manager to see how different activities effect the project.

If the power and use of CPM to monitor a project is now apparent, one weakness also crops up. In the real world, few things are certain. When a project manager specifies the duration for an activity, he is often guessing. When the manager has solid experience, he may be more accurate. However, all too often an activity may not have been performed previously.

In situations of uncertainty, PERT is more useful since it anticipates three activity durations: the most likely, the most optimistic, and the most pessimistic. The most likely activity duration is the one that occurs most often when repeated many times. Statistically it is equal to the mode.

The most optimistic estimation is a minimum time estimate, which can only be obtained with unusually good luck. The most pessimistic duration is the maximum time that the activity can require, a result of unusually bad luck. (Neither the most optimistic nor most pessimistic figures take "catastrophies" into account.)

From these three possibilities, the mean and standard deviation are calculated:

$$\text{mean} = (\text{MO} + 4 * \text{ML} + \text{MP}) / 6$$

$$\text{stan. dev.} = (\text{MP} - \text{MO}) / 6$$

Activity	Activity Description	Predecessor	Duration (min)
A	Fabricate board A	—	15
B	Fabricate board B	—	20
C	Stuff board A	A,B	50
D	Stuff board B	A,B	20
E	Calibrate board B	D	40
F	Test widget	C,E	20

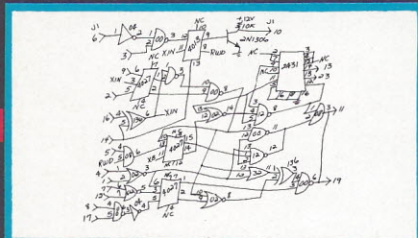
Table 1. Precedence table for the widget project.

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1

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Computer straightens slanted lines, uses correct size symbols and enters alignments among symbols entered by user during input. Plotter output. (Calcomp 1051)

CONNECTION NET LISTING

AD12789 GENERATED 4/13/79 AT 3:01:09 PAGE 1					
SIGNAL NAME	UNIT	PIN	SHLUT	ZONE	
NET001	A1	1	1	A1	
NET001	U1	1	1	A1	
NET002	U1	2	1	A1	
NET002	U2	1	1	A1	
NET003	A1	3	1	A1	
NET003	U2	3	1	A1	
NET004	U2	3	1	A2	
NET004	U3	12	1	A2	
NET005	U2	8	1	B1	
NET005	U2	13	1	C2	
NET005	U11	13	1	D2	
NET005	U7	10	1	D2	
NET005	U4	10	1	C2	
RWD	U2	5	1	C1	
RWD	U3	8	1	D1	
XIN	U3	11	1	A2	
XIN	U8	1	1	D2	
XIN	U8	1	1	D1	
XIN	U4	5	1	D1	

BILL OF MATERIALS

BILL OF MATERIALS FOR DRAWING NUMBER AD12789			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	054-4060	SN7404N
2	12	054-002	SN7402N
3	8	054-6080-67	RESISTOR 1.5K 1/2W 5%
4	2	079-5784-1	ZENER DIODE 1N821 6.2L
REFERENCE DESIGNATOR	PART NUMBER	DESCRIPTION	
CR1	079-5784-1	ZENER DIODE 1N821 6.2L	
R1	054-6080-67	RESISTOR 1.5K 1/2W 5%	
U1	054-4060	SN7404N	
U2	054-002	SN7402N	

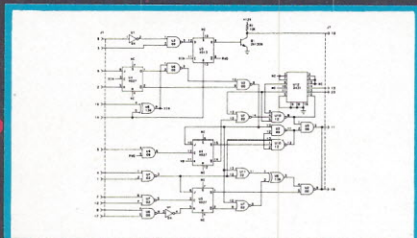
"DS1" automatically provides Net and Bill Lists directly from data base of digitized schematic.

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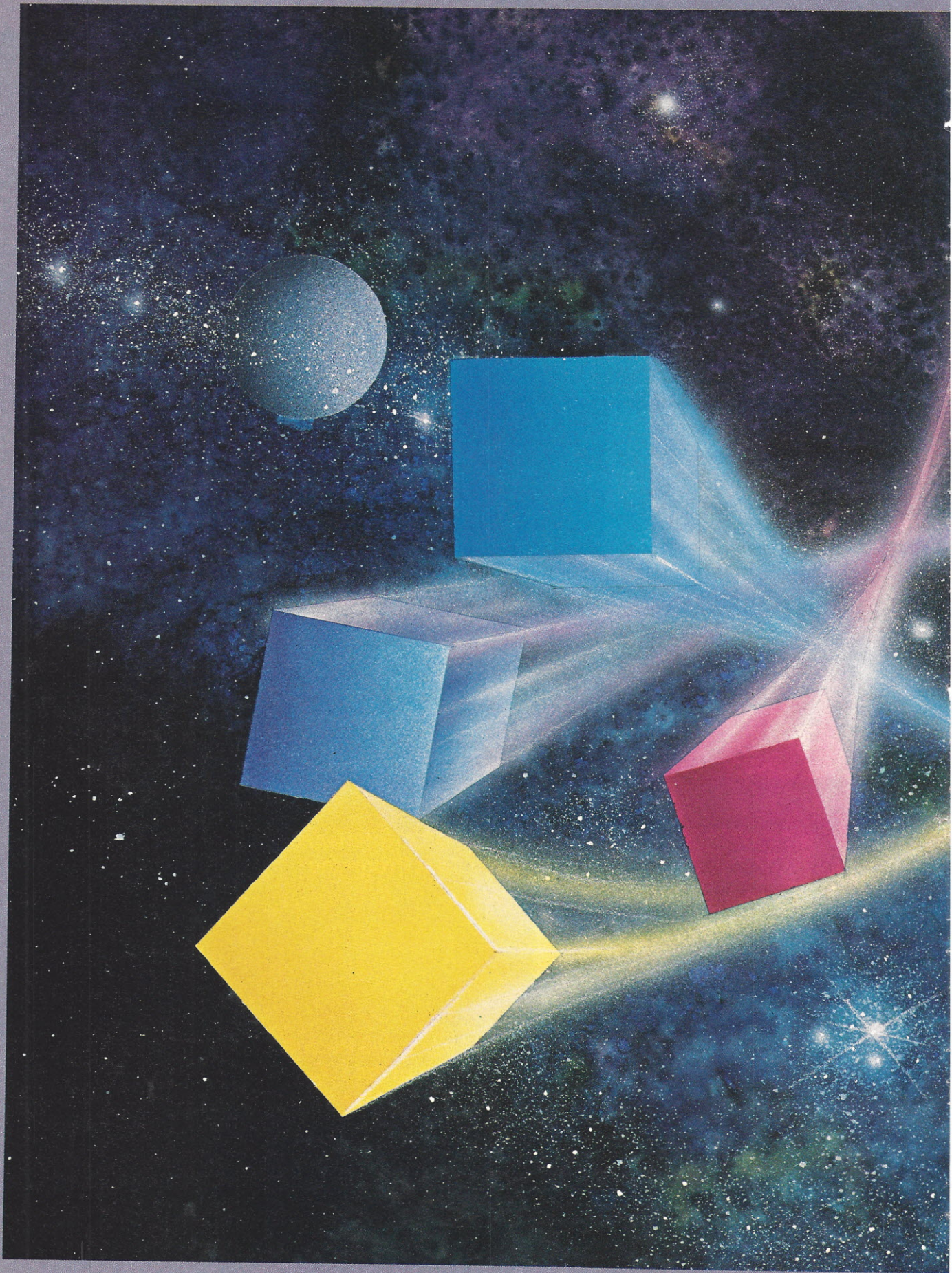



"DS1" performs Back-Annotation from a "Was-To" list derived from the P.C. Router. "Back-Annotation" automatically updates the schematic to agree with the circuit board component placement.

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CIRCLE INQUIRY NO. 22





MICROCOMPUTING— AT THE SPEED OF LIGHT

by Eric T. Lane, Ph.D

How does an object look as it passes at half the speed of light? How would a city look in a picture taken from a spaceship going 184,000 miles-per-second?

The Theory of Relativity appears difficult. Yet many of the ideas that Einstein proposed can be converted into easily understandable pictures. The microcomputer makes it possible, thus it can provide valuable insight into concepts hidden within apparently difficult mathematical concepts.

An example of this difficulty is that an object can't go faster than the speed of light. What should be noted is that the image we see appears to move at a speed less than that of light. Some confuse the image with the object. They are especially liable to do this since the only way we can observe an object is with light. Thus they confuse our attempt to explain what we see with what 'is'.

Since all we have to see with is light, we'd better learn to figure out what we see. What do we expect to see when an object moves very fast?

It takes different times for light to get from different parts of an object to the eye or to a camera lens. Imagine a very fast camera set to take pictures of an object as it moves past. Let's say that it's long and flat...a flying carpet. Let it move sideways to make the picture easier to understand.

As the carpet moves toward us, it looks larger than it actually is. We can see this by noting that the light from the back of the carpet had to start out earlier than the light from the front of the carpet nearest to us in order for the light from both parts to get to us at the same time.

The carpet will appear to be twisted. The light from the farthest corner will take longest to get to us and will appear in the picture to be farthest away. Thus it had to be sent out earlier than any of the other points, that is when the whole carpet was farthest away.

As the carpet moves away from us, it looks narrower in the direction of its motion than it

Illustrated by Fino Ortiz

actually is. The principle is the same as when it is moving toward us: light takes longer to get to us from parts of the carpet farthest away. Now the light has to leave those parts earlier so that all the light gets to us at the same time to make a picture.

Speed of light from outer space

Will we observe a different effect if we, rather than the object, are moving? The answer is that the effect will be exactly the same because it is the relative velocity between the object and the observer that determines what we see. For example, if we were in a spaceship moving past the carpet, we would see exactly the same thing as when it moved past us with the same velocity.

To see more clearly what this looks like, consider how a city would look as we move past at high speed. Imagine that the city is laid out on a square grid of streets and that street lights are placed at each corner. The same effect that we saw with the carpet is going to occur. The farther away a point is when we snap the picture, the earlier the light would have to leave that point so that all the light gets to us at the same time the camera shutter opens and closes. Thus street lights ahead of us appear to be much farther away than they actually are and lights behind us appear to be closer.

Now there is one more effect that we have to take into account: the velocity of light is 186,000 miles-per-second regardless of how we measure it. Even if we are moving and the source of light is moving in an entirely different direction, the velocity of light is still exactly the same.

The only way that we can account for this effect is to put in a factor that exactly cancels out the relative motion between the light source and the observer. This factor was discovered by Lorentz in the last century and we can use it to picture how an object looks if we see it moving at a velocity close to 186,000 miles-per-second.

Since it is easier to understand, let's consider the street light grid program first. This has line numbers 3000 to 3110. Note that all we're doing is choosing the real positions of the street lights at XR and YR. We convert this to the apparent position XA and YA. Note that the Y value doesn't change; the X value does. We calculate XA using the equation derived in the appendix. The variable LC is the Lorentz contraction factor and RV is the ratio of the velocity of our spaceship to the velocity of light—that is the percentage PC divided by 100.

When you run the program, try 0% for the speed of light to see what the grid looks like when we're standing at the ninth street light from the right. Then try 10%, 20%, up to 99% to see how the grid would look if we took a picture just as we passed the ninth street light moving from right to left at the speed indicated. Note that the faster we go, the more distorted the picture. Our eye or our camera appears as the ^ mark next to the grid.

Start the program at zero

The flying carpet display starts at line 2000. It may appear more complicated, but that's just to make the display look as if it's moving. The basic principle is the same as for the street light grid. We place a set of points in the real positions that you can see by running this part of the program at 0% of the speed of light. We

compute where these points will appear if the carpet is moving at velocity V.

Finally we plot the shape of the carpet as it would appear if we took a set of pictures of it as it moved past. Note that for velocities larger than 75% of the speed of light, the distortion is so great that the farthest points aren't even on the screen. But to keep the program complexity within bounds, we don't try to eliminate these points, simply plotting all of them at the left edge of the screen.

This brings us to several possibilities open to further development. For example, the plots displayed do not show perspective as a real picture would. Can you program so that the picture shows perspective? This would be especially important if you wanted to consider plotting what a three-dimensional object might look like. Imagine a cube with lighted edges moving past us. How would it look? To get the answer, just treat the Z-coordinate exactly the same as the Y-coordinate.

If you really want a challenge, try to figure out how you might plot a stereoscopic view. Say, one image with green and the other with red. □

Street Light Grid and Flying Carpet Program

```

1000 REM RELATIVISTIC SHAPES
1010 REM APPLE 11

1020 DIM X(2,10),Y(10)
1030 TEXT : HOME
1040 VTAB 4: HTAB 12
1050 PRINT "RELATIVISTIC SHAPES"
1100 VTAB 13: HTAB 12
1110 PRINT "1 MAGIC CARPET"
1120 PRINT : HTAB 12
1130 PRINT "2 STREET LIGHTS"
1140 PRINT : HTAB 12
1150 PRINT ". END PROGRAM"
1160 PRINT : HTAB 12
1170 PRINT " CHOICE ";
1180 POKE - 16368,0
1190 INPUT I
1200 IF I < = 0 THEN 9999
1210 IF I < 1 OR I > 2 THEN 9999

1220 VTAB 22: PRINT "PERCENTAGE
      OF THE SPEED OF LIGHT ";
1230 HTAB 34: INPUT PC
1240 IF PC < 0 OR PC > = 100 THEN
      VTAB 23: PRINT " MUST
      BE BETWEEN 0 AND 99% "
      GOTO 1230
1250 TEXT : HOME : PRINT
1260 VTAB 22: PRINT PC;" PERCENT
      OF THE SPEED OF LIGHT "
1270 VTAB 21: HTAB 29: PRINT " ^ "

1280 RV = PC / 100
1285 REM RV IS THE RATIO OF THE
      VELOCITY TO THE SPEED OF LIG
      HT
1290 LC = SQR (1 - RV * RV)
1295 REM LC IS THE LORENTZ CONTR
      ACTION FACTOR
1300 ON I GOTO 2000,3000
1310 GOTO 1030
2000 REM MAGIC CARPET
2010 FOR XO = - 50 TO 80 STEP 7

2020 REM COMPUTE DISTORTION

```

Continued on page 136

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COMPUTER GRAPHICS: MANUFACTURER BY MANUFACTURER

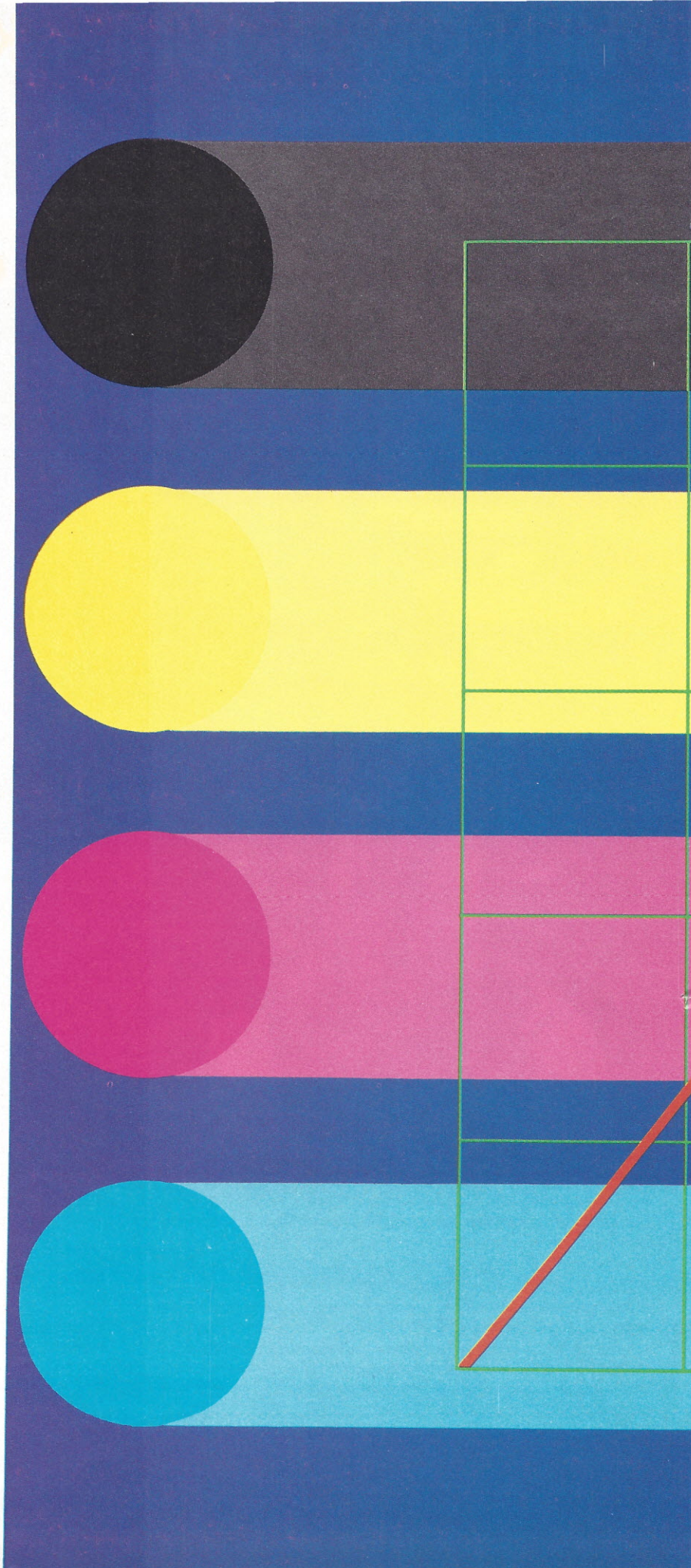
by Michael and Alan LocEFF

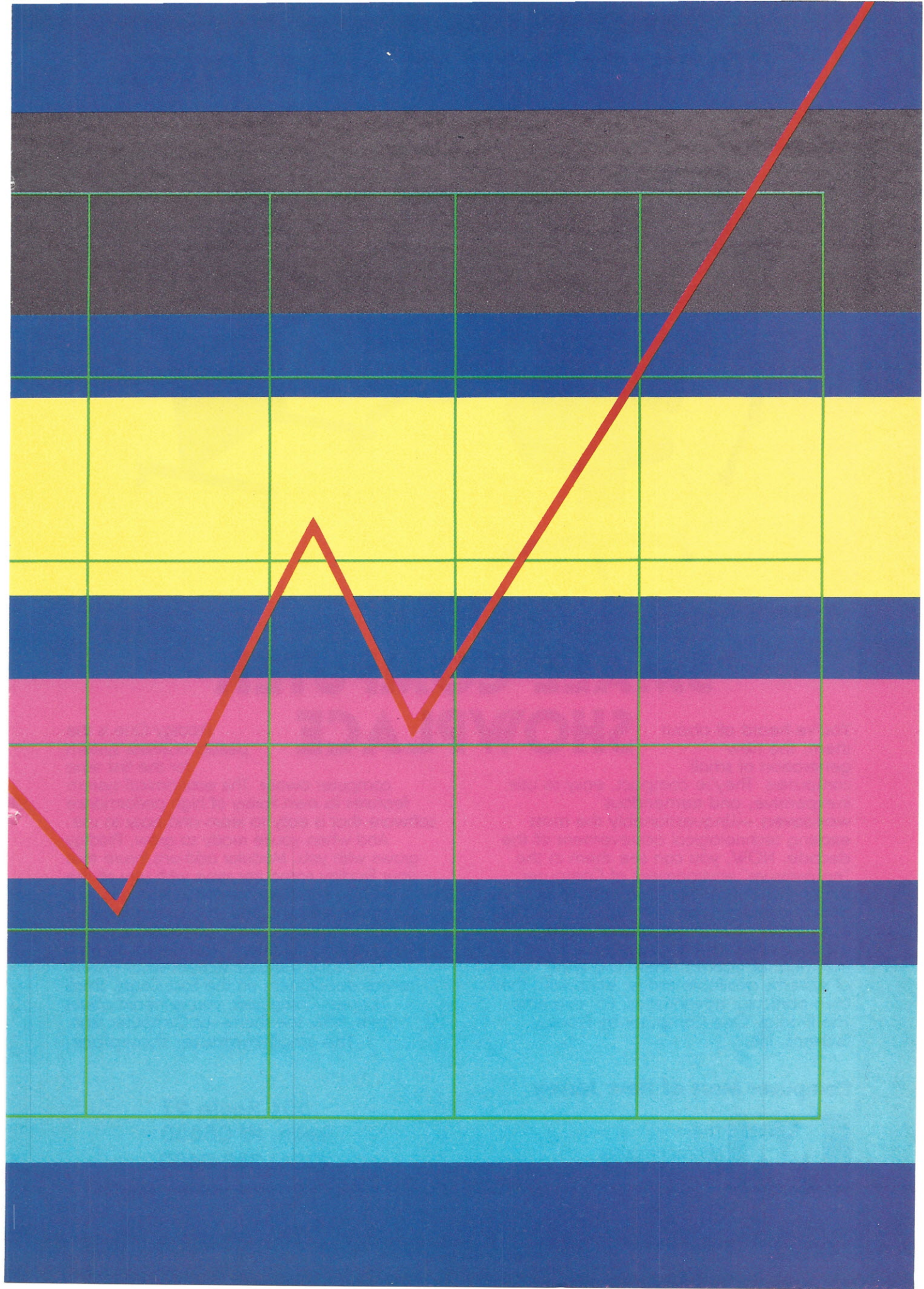
Purchasing a computer graphics system for the first time will involve a great deal of time and research. The consumer needs to be aware of the strengths and weaknesses of various equipment, as well as the particular applications that will best fit his needs. Although the following is a manufacturer—not a product—survey, it provides a good start for consumer investigation.

Resolution and prices are given as a range representing each manufacturer's product line. Hopefully the reader will contact those manufacturers which offer price/performance specs for his particular application to get more specific, direct information.

Emphasis was given to two aspects of graphics: overall system configuration and local processing capability. While these categories usually are left unsurveyed, the authors consider these factors crucial to the usefulness of the product line. A key is supplied in figure 1 to facilitate classification of these two properties.

The category "Standard Formats Supported" is included for those users interested in broadcast applications that require external sync lock capability or NTSC compatibility. The absence of a listing for a particular manufacturer does not necessarily mean that these capabilities are lacking; merely that we could not obtain specific information. To be certain, check with the manufacturer directly. □





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Adage Billerica, MA	Calligraphic	5	IBM 360/370 or mini	c local processor and firmware	Host	.006 in/min line width	4 textures 64 gray levels 4 colors	750,000 in/sec write	21	—	dt, joy, tb, kybd	\$40M-\$100M
Advanced Electronics Design Sunnyvale, CA	Raster	2	RS-232, parallel	d 6502A with Prom and RAM	Aegraf (high level) or other low level	512 by 480 to 512 by 512	256 of 2 to the 24th (look up table)	—	14, 19	—	kybd, joy	\$10M-\$18M
Ayden Controls Fort Washington, PA	Calligraphic Raster	3, 4, 5, 6	RS-232, parallel	c hardware graphics generators	Turnkey	1024 by 1024	stroke: b/w to 4 colors raster: 1.12 bits/pixel	40,000 to 500,000 in/sec	10-23 rect. or round	—	lp, kybd	—
Calcomp Anaheim, CA	Calligraphic	2, 5, 6	any host	Multi-local processors	Fortran, host	1024 by 1024 to 2048 by 2048	b/w to 4 colors	25,000 to 250,000 in/sec	21	—	joy, lp, kybd, dt	\$15M-\$42M
Chromatics Tucker, GA	Raster	1, 2	sa or or any host	d	Pascal, Basic, CP/M, Z-80	512 by 256 to 512 by 512	8 foreground, 8 background	—	13, 15, 19	—	kybd, fk, dt	\$6M-\$12M
Comtal Altadena, CA	Raster	4, 5, 6	sa or or any host	c multi-local processors	self contained firmware, Image Processing	512 by 512 to 1024 by 1024	1 to 24 bits/pixel	—	—	—	tb, kybd, dt, fk	\$32M-\$180M
Cromemco Mountain View, CA	Raster	3, 4, 5, 6	sa, Parallel to micro RS-232	b	Fortran, Basic, Z-80 Graphics Editor	378 by 241 to 756 by 482	16 of 4096 (look up table) to 12 bits/pixel	—	13, 19	NTSC, PAL, external sync lock	dt, joy, kybd	\$5M-\$28M
De Anza Systems San Jose, CA	Raster	3, 5	parallel to mini	c multi-local processors, LSI-11	Fortran, host	256 by 256 to 1024 by 1024	8 bits/pixel to 4096 colors	—	13, 19	—	lp, joy, tb, kybd	\$8M-\$120M
Digital Equipment Corporation Sunnyvale, CA	Raster	2, 5, 6	PDP-11, VAX-11 and LSI-11 bus micros	c, d	Fortran, Basic, host	512 by 256 to 1024 by 1024	b/w to 16 colors	—	9.25 by 9.25 to 19	—	kybd, joy	\$8M-\$37M
Digital Graphics Systems Palo Alto, CA	Raster	3, 4	S-100 bus	a	8080, Basic, CP/M	240 by 256 to 480 by 512	b/w to 16 bits/pixel	—	15	NTSC, external sync lock	lp, cd	\$1.5M-\$12M
Evans and Sutherland Salt Lake City, UT	Calligraphic Raster	3, 4, 5, 6	PDP-11 or VAX	c multi-local processors	Fortran, Macro-11	.015 in-.040 in line width (calligraphic), adjustable	64 hue, 7 saturation	2.6-5.7 μ sec/inch write	26	—	dt, lp, fk, joy, kybd	\$70M-\$150M
Genisco Costa Mesa, CA	Raster	3, 4, 5	mini	b, c 16 bit microprocessor	Grafpac (Fortran)	512 by 512 to 1280 by 1024	b/w to 4096	—	13, 14	—	—	\$10M-\$50M
Grinnell Systems San Jose, CA	Raster	3, 5	Parallel to any mini	c multi-processors and hardware functions	Fortran and low level drivers	256 by 256 to 1024 by 1024	8 bits/pixel	—	—	external sync lock	joy, tb, cd	\$13M-\$83M
Hewlett-Packard Ft. Collins, CO	Raster	1, 2, 6	sa or RS-232	c	Basic, business routines	720 by 360 to 560 by 455	b/w or 4913 (via dither)	—	11, 13	—	kybd	\$5.5M-\$10M
IBM	Calligraphic Raster	2, 5, 6	IBM 360/370	c, d	host	1024 by 1024	b/w or color	350,000 in/sec	12 by 12	—	kybd, lp, fk	\$35M-\$90M
Ikonas Raleigh, NC	Raster	5	RS-232 or dma from mini	b, c multi-local processors	assembly (Iksam) and firmware routines	512 by 512 to 1024 by 1024	4-16 bits/pixel 1K (look up table)	—	19	NTSC compatible	cd, kybd	\$20M-\$70M
Imlac Needham, MA	Calligraphic	2	RS-232	d 8086	Fortran, host	1024 by 1024 to 2048 by 2048	monochrome	80,000 in/sec	19	—	kybd, lp, joy, dt	\$15M-\$25M

Continued on following page

	1 TECHNOLOGY	2 SYSTEM CONFIGURATION (see key)	3 HOST REQUIRED OR HOST INTERFACE	4 LOCAL PROCESSING CAPABILITY (see key)	5 SOFTWARE SUPPORT	6 (Spatial)	RESOLUTION (Color)	7 VECTOR SPEED (Callig/DVST only)	8 DISPLAY SIZE (inches)	9 STANDARD FORMATS SUPPORTED	10 INPUT/OUTPUT OPTIONS	11 PRICE RANGE
Lexidata Burlington, MA	Raster	3, 5	Data General and most minis	c local processor	Fortran IV and V, assembler	256 by 256 to 1024 by 1280	1-16 bit/pixel	—	13, 14	external sync lock	tb, fk, joy	\$7M-\$30M
Intelligent Systems Corp.	Raster	1, 2, 6	RS-232 or others optional	d 8080A	CP/M, Microsoft Basic, Business Pkg.	160 by 192 to 384 by 480	8 foreground 8 background	—	13, 19, 25	—	kybd	\$2M-\$12M
Megatek San Diego, CA	Calligraphic Raster	3, 4, 5	RS-232, parallel; mini or mainframe	c bipolar bit-slice	Wand, Template	4096 by 4096	calligraphic: b/w or beam penetration raster: 16 of 4096 (look up table)	—	21, others optional	—	kybd, fk, lp, joy, dt	\$30M-\$60M
Ramtek	Raster	2, 3, 4, 5, 6	sa, RS-232 or other	b, c, d	UCSD Pascal, Grafpro high level binary	320 by 240 to 1024 by 1280	3-24 bits/pixel	—	13 to 25	RS-170, RS-343A	joy, kydb, dt	\$6M-\$100M
Sanders Associates Nashua, NH	Calligraphic Raster	2	mini/mainframe	d	Fortran, host	1024 by 1024 to 2048 by 2048	calligraphic: 4 raster: 256	25,000 to 250,000 in/sec	21, 24	—	joy, lp, dt, kybd	\$32M-\$50M
Tektronix Beaverton, OR	DVST Raster	1, 2, 6	sa, IEEE 488-1975 or RS-232	b, c	PLOT=10, APL	1024 by 780 to 2048 by 1536	64 possible on raster	56,000 cm/sec refresh 14,000 cm/sec storage	11 to 25	—	joy, fk, kybd	\$4M-\$20M
Terak Scottsdale, AZ	Raster	1, 2	sa or serial	d LSI-11	Basic, Fortran, APL, Pascal	320 by 240 to 640 by 480	b/w to 64 of 512 (look up table)	—	12	—	kybd	\$8M-\$20M
Vector General Woodland Hills, CA	Calligraphic	5	any mini via parallel	c multi-local processor	Fortran, PDP-11 assembly	4096 by 4096	6 line textures	20,000 25 in vectors at 30Hz	21 to 22	—	kybd, fk, dt, joy	\$20M-\$80M

dt = data tablet
joy = joystick
tb = track ball
kybd = keyboard
lp = light pen
fk = function keys
cd = camera diltizer
sa = stand alone

Key to I/O abbreviations

System configuration

- Stand alone desktop graphics computer.
- Graphics terminal—host not included.
- Graphics interface and video generators—not including host or display.
- Display only—not including host or graphics interface.
- Graphics add-on: graphics interface and video generators plus display—host not included.
- Complete modular graphics system: general purpose host plus graphics add-on.

Local processing capability

- Interface only—no local processing.
- Limited local intelligence.
- Graphics workstation: complete local processing including I/O handling.
- Intelligent terminal with local mode.

Figure 1. Key for categories 2 and 4 of survey.



**I started
by selling programs,
and a year later
they said I was
“the standard
of the industry.”**

**Now I'm selling
the whole computer.**

I'm Irwin Taranto, the one who changed the TRS-80* into a serious business computer.

Thousands of businesses tried my programs in the last year and a half, and sometimes it seems like every one of them has called me on the phone. With every call, I get another idea. I polish, alter, upgrade and correct these programs constantly.

By now I know how they work best, and exactly what they need in the way of peripherals. It's only logical that I should sell the whole computer system, not just the program diskettes.

So if you look at the computer in the picture, you'll see it says “Taranto” on it, not “TRS-80.” The keyboard and CRT unit are a Tandy II*

*Trademarks of the Tandy Corporation

(that's what the manufacturer calls TRS-80 Model II when it's not sold through the Radio Shack). If it fits your needs better, though, we'll get the disk drive or the line printer somewhere else.

When you buy one of these Taranto computers, you get some serious advantages.

Some serious advantages.

You get hardware that's absolutely tailored to my programs. This means you'll be able to use every bit of the capability that's built into these systems.

You get my backup, down the line. And the manufacturer's repair and service guarantee on all the hardware. If something goes wrong, we tell you how to fix it over the phone. If the problem's tough enough, I get on the phone myself. If we find out it's a hardware problem, any Radio Shack Service Center will fix it under Tandy's guarantee, even though it says “Taranto” on the machine.

In a lot of cases, we can help you set it up, too. I'm putting a group of authorized dealers together. Before long, they'll be all over the country, able to bring the equipment and programs right to your business. They'll spend a day or so with you helping you shake it down. It'll cost a little more, but it's good insurance.

The programs.

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- Open Items Accounts Receivable/Invoicing
- Balance Forward Accounts Receivable (new)
- Payroll/Job Costing
- Inventory Control (new)

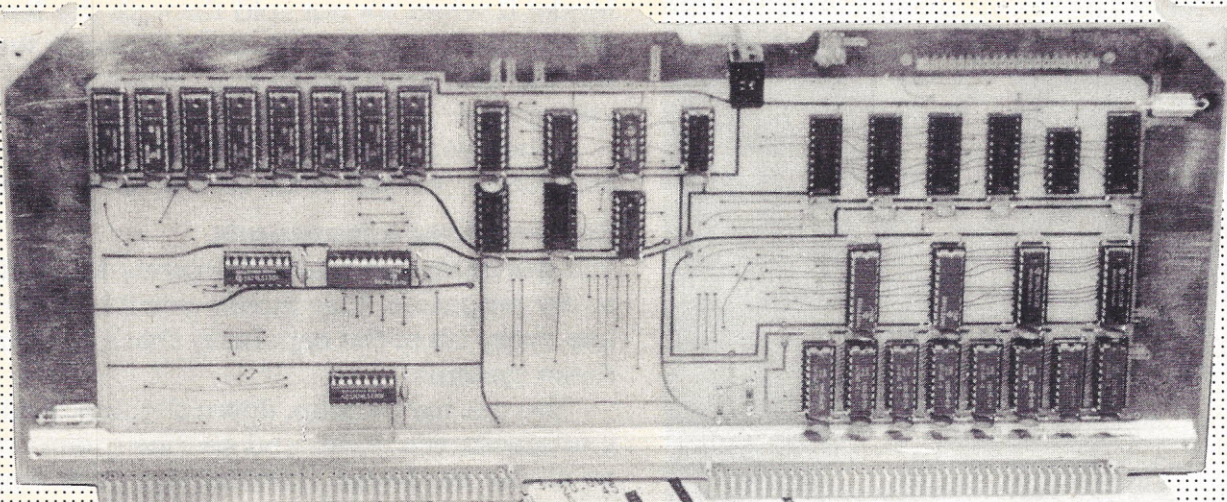
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A Business Printer Goes Graphic

by Tom Fox

Texas Instruments' TI810 has a solid reputation for being a printer you can rely on. Originally designed to print airline tickets, the system is fast for a serial unit: 150 characters-per-second. It utilizes a dead simple dot matrix design and enough electronics to rank it among the smartest of the under-\$2,000 paper gobblers. By itself, though, it only knows one kind of output: straight Ascii numbers and letters, upper and lower case. It makes no pretense at anything fancier.

Enter Analog Technology Corp. (Irwindale, CA), a young company that builds laboratory test and data reduction computers. Its machines routinely correlate thousands upon thousands of experimental test readings and combine them into human-readable charts and graphs. Output is generally to graphics terminals of Tektronix, Hewlett-Packard or Digital Equipment variety. This is fine for instantaneous reading and results interpretation, but a problem rears its head when the researcher wants a hard copy.

The problem is an old one: money. Once you've paid the price of a Tektronix graphics display terminal, there is often too little left in the treasury to purchase the hard copy attachment. Many laboratories make do with

Polaroid shots of the terminal screens, but the resulting small photograph is usually unsatisfactory to record an experiment for posterity. A better way is needed.

The engineers at ATC started poking around inside a TI810 printer, and discovered that there is no mechanical reason the device should limit itself to banging only letters and numbers onto the page. With a little intelligent guidance, the print hammers could be coerced into making a pattern of black dots *anywhere* on the paper. In fact, an entire sheet could be blotted out under black ink.

It turns out that the printer has a spare slot for a circuit board, and nearly all of the picture-making smarts will fit nicely onto that extra board. ATC sells such add-in circuit boards, along with a replacement ROM chip to substitute for one on another part of the internal printer circuitry.

Installation could hardly be simpler, the results are spectacular. Because the printing hammers are tiny and the 11-in by 11-in paper so large, over 1.6 million dots can be individually addressed on a single sheet. That's a resolution of 120-dots-per-inch horizontally and 72-per-inch vertically. Picture clarity is equal to

many of the display terminals installed in this kind of computer system. Don't look for multi-color capability in this printer/plotter, however. That costs a lot more money, and few specialized printers and plotters have that field all to themselves.

It seems strange to apply the term "raster scanning" to a printing mechanism, but that's how the ATC/TI810 hybrid works. TI didn't anticipate a need to roll the paper backwards when it designed the TI810, so pictures must be drawn from the top down *only*. It's up to the programmer to come up with a way to format an image of the picture in memory first, and then dump it to the printer a single row of dots at a time. The technique is akin to the refreshing sweeps on an ordinary raster-scan CRT. The big difference is that the image only has to be scanned once—the persistence of ink on paper is *very* long. Writing graphics software is always a tedious, demanding task, and this is no exception. We would expect a Basic or Pascal-only programmer to face some tough challenges trying to produce pretty pictures. Perhaps someone will come up with a set of assembly-language routines to ease the task.

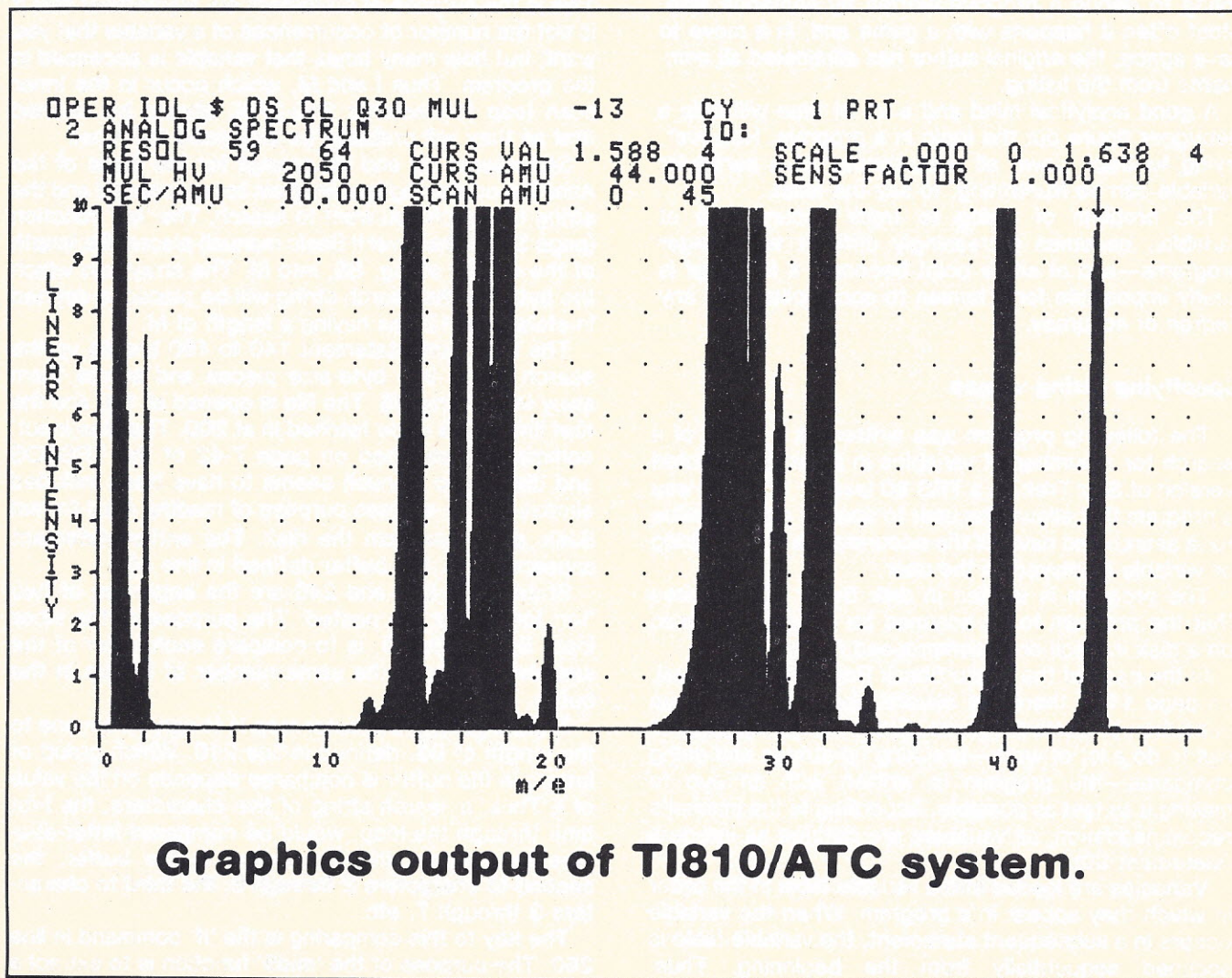
One of the add-on board's tricks seems unique enough to justify the cost by itself, and it isn't even in the graphics category. The unit has a mode where it will "listen" for the computer to define a special character set. Each character can be anything that will fit into a 7 by 12-dot matrix, and a different character can be loaded for each of 75 Ascii character codes.

Once the character set has been defined, subsequent transmissions to the printer cause new characters to print whenever normal Ascii codes are transmitted to the device. We can envisage an application where this could be used to print rough drafts of typeset material for proofreading—with a close approximation of the type fonts appearing much as they would in the final typeset form. Foreign languages and scientific formulas would be a natural, as would APL program listings. These tasks are nearly impossible on ordinary printers.

According to the manufacturer of the add-on board, TI has seen the device in action, and has agreed to honor the factory warranty of any TI810 equipped with it—except for the dot-matrix print head itself. There's no doubt that the head *could* work a lot harder drawing pictures than printing letters, and such abuse is highly dependent on the kinds of pictures being drawn. We wouldn't bet against the basic ruggedness of the TI mechanism, however.

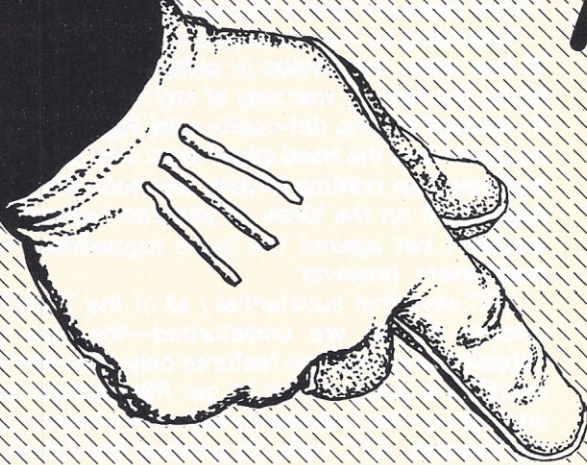
ATC says that substantially all of the TI810's native printing talents are undisturbed—the new graphics capabilities are add-on features only. You don't have to sacrifice a good printer to get this picture capability. Just turn on the features by software commands as they are needed. ATC calls its product the Omni-graphics board, and it comes with a 28-page manual for \$875.

Tom Fox can be reached at FoxWare Systems Corp., 17925-G Sky Park Circle, Irvine, CA 92714, (714) 957-9332. □



Tracking Variables in Applications Programs

by Rocky Smolin



VARIABLES VARIABLES VARIABLES VARIABLES VARIABLE

Most computer users have undertaken the task of trying to debug a program written by someone else. Most often it happens with a game and, in a move to save space, the original author has eliminated all comments from the listing.

A good analytical mind and a lot of time will help a debugger figure out the logic in a program. However, trying to track down all occurrences of a particular variable can be frustrating, to say the least.

The problem of trying to track occurrences of variables becomes increasingly difficult with longer programs—and at some point becomes a task that is nearly impossible for a human to accomplish with any degree of accuracy.

Specifying string values

The following program was written as a result of a search for a number of variables in an undocumented version of Star Trek on a TRS-80 level II. The goal was a program that allows the user to specify a string value for a search and have all the occurrences of that string or variable displayed to the user.

The program is written in disk Basic and requires that the program to be scanned be previously stored on a disk in Ascii or uncompressed format.

In the back of the Radio Shack Basic level II manual, on page 11/2, there are several tips on speeding up execution of Basic programs. Since the string scanner has to do a lot of work—breaking up strings and doing compares—the program is written with an eye to making it as fast as possible. According to the manual's recommendation, all variables are defined as integers (statement 20).

Variables are loaded into a variable table in the order in which they appear in a program. When the variable occurs in a subsequent statement, the variable table is scanned sequentially from the beginning. Thus,

variables that occur most often should be defined first. This is the purpose of statement 40. Remember that it is not the number of occurrences of a variable that you want, but how many times that variable is accessed in the program. Thus I and M, which occur in the inner scan loop (statements 240-270), should be defined first as they will probably be accessed the most.

Statements 80 and 90 prompt for the name of the Ascii file containing the program to be scanned and the string for which you want to search. The 'len' function (page 5/6 of the level II Basic manual) places the length of the search string, S\$, into M. The array into which the bytes of the search string will be placed is defined in statement 120 as having a length of M.

The loop from statement 140 to 160 breaks up the search string into byte-size pieces and stores them away in the array X\$. The file is opened at 180 and the first line of the code fetched in at 200. The 'line input' command, (described on page 7-42 of the TRSDOS and disk Basic manual) seems to have been included almost for the express purpose of reading Ascii-format Basic programs from the disk. The entire statement appears in B\$, the buffer defined in line 40.

Statements 230 and 240 are the beginning of two 'for' loops that are nested. The purpose of the inner loop, lines 240-270, is to compare each letter of the search string with the same number of letters in the buffer, B\$.

The purpose of the outer loop is to vary I from one to the length of B\$, defined in line 210. Which group of letters in the buffer is compared depends on the value of I. Thus, a search string of five characters, the first time through the loop, would be compared letter-at-a-time to the first five characters in the buffer, the second to characters 2 through 6, the third to characters 3 through 7, etc.

The key to this comparing is the 'if' command in line 260. The purpose of the 'mid\$' function is to extract a

portion or sub-string of the contents of a string variable. It uses three parameters: the first is the name of the string variable, the second is a pointer to the starting position of the sub-string, the third parameter gives the length of the sub-string.

Assume that the length of the search string, M is 5. The first time through the outer loop, while I is equal to 1, and as K increments from 1 to 5 in the inner loop, the value of the expression $I + K - 1$ will vary from 1 to 5. It will vary from 2 to 6 the second time through the outer loop, and so on. If, at any point during the byte-by-byte compare, a mismatch is found, the program exits the inner loop to line 360, the terminator of the outer loop.

If no mismatches are found, the program falls through to the output routine (statements 290-330). A string, A\$, is filled with L number of spaces (the length of B\$ from line 210). Since I still points to the place in the buffer with the search string, it can be used as an index in line 300 to insert an asterisk into A\$. Printing them one after the other (lines 320-340) shows where the string occurs by placing the asterisk under it.

When the outer loop is exhausted, the program falls through to statement 380. The EOF function checks to see if all the records in the file have been read. If the end-of-file has been reached, the condition is true and the program stops. If not, control is transferred to statement 200 and the next record in the file is read. □

PROGRAM LISTING

```

10 REM          DEFINE ALL VARIABLES AS INTEGERS FOR SPEED
20 DEFINT A-Z
30 REM          DEFINE VARIABLES IN USE ORDER FOR MORE SPEED
40 K=0:M=0:B$="":I=0:L=0
50 REM          CLEAR SOME STRING SPACE
60 CLEAR 500
70 REM          GET THE NAME OF THE FILE CONTAINING THE PROGRAM
          TO BE SEARCHED AND THE STRING TO SEARCH FOR
80 INPUT "FILE NAME ";F$
90 INPUT "STRING ?";S$
100 REM         RESERVE A CHARACTER STRING ARRAY FOR THE SEARCH STRING
110 M=LEN(S$)
120 DIM X$(M)
130 REM         PLACE THE LETTERS OF THE SEARCH STRING INTO THE ARRAY 'X'
140 FOR I=1 TO M
150 X$(I)=MID$(S$,I,1)
160 NEXT I
170 REM         OPEN THE FILE TO BE READ
180 OPEN "I",1,F$
190 REM         GET THE NEXT COMPLETE LINE OF TEXT; STORE ITS
          LENGTH IN 'L'

200 LINE INPUT #1,B$
210 L=LEN(B$)
220 REM         SCAN THE STRING USING I AS AN INDEX OR POINTER
230 FOR I=1 TO L
240 FOR K=1 TO M
250 REM         IF THE LETTERS DON'T MATCH, GO TO THE NEXT LETTER
260 IF MID$(B$,I+K-1,1) <> X$(K) GOTO 360
270 NEXT K
280 REM         ALL THE LETTERS MATCHED; CREATE A$ TO SHOW WHERE
290 A$=STRING$(L," ")
300 MID$(A$,I,1)="REM"
310 REM         PRINT THE TWO STRINGS AND A SPACE
320 PRINT B$
330 PRINT A$
340 PRINT
350 REM         CONTINUE TO SCAN THE INPUT BUFFER FOR A MATCH
360 NEXT I
370 REM         CHECK FOR LAST RECORD IN THE FILE
380 IF EOF(1) STOP
390 GOTO 200

```

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Apple - SoftCard 16 SectorRR	CP/M 2.2D2#	REXQ3
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Blackhawk Single DensityQ3	IMSAI VDP-40R4**	SD Systems 5 1/4"R3
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DeltaA1*	Intertec SuperBrain DOS 0.5-2-XRJ	TRS-80 Model I 5 1/4"R2
Digi-Log Microterm IIRD	Intertec SuperBrain DOS 3.XRK	TRS-80 Model I + FEC FreedomR1
Digital MicrosystemsA1*	ISC Intecolor 8083/8360/8963A1	TRS-80 Model I + MicromationA4*
Discus	See Morrow Discus	Kontron PSI-80RF	TRS-80 Model I + Omikron 5 1/4"RM
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Dynabyte DB8-2R1	Micromation		TRS-80 Model I + Shuttleboard 8"A1
Dynabyte DB8/4A1*	(Except TRS-80 below)A1*	TRS-80 Model IIA1*
Exidy Sorcerer - Lifeboat CP/MQ2	Micropolis Mod IQ1	VDP-40/42/44/80	See IMSAI
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Heath H8 - H17/H27P4	MITS 3200/3202B1	Vector MZQ2
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Horizon	See North Star	North Star Single DensityP1	Zenith Z89 - Lifeboat CP/MP4
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		Ohio Scientific C3A3		
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* Single-Side Single-Density disks are supplied for use with Double-Density and Double-Side 8" soft sector format systems.

** IMSAI formats are single density with directory offset of zero.

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Amortization Schedule

by Gary A. Stotts

Here is a program that will show where your money is going when you pay off an installment loan. It will also let you compare monthly payments for loans of various lengths and interest rates. It is written for an Apple microcomputer.

Operation of the program is simple. Enter the amount of the loan, the interest rate as a decimal, and the terms of the loan in years. Output is the monthly payment for each month of the loan. The following will also print: the portion of the monthly payment going to interest, the portion of the payment going to principle, the principle balance after making the payment, and the total interest paid to date.

Applesoft does not have a print using statement. The function in line 30 is used to round calculations to the nearest cent. The subroutine in lines 400-530 is used to simulate a print using statement. Input to the subroutine is X\$, the number to be printed, D, the number of decimal places, and SP the number of print positions from the end of the prior number to the end of the current number. The subroutine will find the number of decimal places actually in the number, and add trailing zeros and/or a decimal point if there are too few decimal places.

The number of print positions to space is calculated in line 510. Line 520 spaces and prints the number. Lines 270-320 are used to prevent lines from scrolling off the display screen. After 19 lines have printed, an operator response is required to continue the program. □

PROGRAM LISTING

```

10 REM AMORTIZATION SCHEDULE
20 REM AUTHOR GARY A STOTTS
30 DEF FN A(W) = ( INT (100 * (W + .005))) / 100
40 INPUT "ENTER AMOUNT OF LOAN ";L
50 INPUT "ENTER THE ANNUAL INTEREST RATE ";R
60 INPUT "ENTER THE TERM IN YEARS ";Y
70 I = R / 12
80 M = Y * 12
90 A = L * I * (1 + I) ^ M / (((1 + I) ^ M) - 1)
100 A = FN A(A)
110 PRINT "THE MONTHLY PAYMENT IS ";A
120 C = 0:B = L:T = 0
130 PRINT "NUM"; SPC( 1);"INTEREST"; SPC( 2);"PRINC"; SPC( 5);"PBAL"; SPC( 4);"TOTINT"
140 FOR J = 1 TO M
150 I1 = FN A(B * I): REM INTEREST
160 P = FN A(A - I1): REM PRINCIPAL
170 IF J < > M THEN 190
180 P = B
190 B = FN A(B - P): REM UPDATE LOAN BAL
200 T = FN A(T + I1): REM TOTAL INTEREST
210 X$ = STR$(J):D = 0:SP = 3: GOSUB 400
220 X$ = STR$(I1):D = 2:SP = 8: GOSUB 400
230 X$ = STR$(P):SP = 9: GOSUB 400
240 X$ = STR$(B):SP = 9: GOSUB 400
250 X$ = STR$(T):SP = 10: GOSUB 400
260 PRINT
270 C = C + 1
280 IF C < 19 THEN 330
290 C = 0
300 INPUT "KEY C TO CONTINUE":C$
310 CALL - 936
320 PRINT "NUM"; SPC( 1);"INTEREST"; SPC( 2);"PRINC"; SPC( 5);"PBAL"; SPC( 4);"TOTINT"
330 NEXT J
340 PRINT
350 INPUT "DO YOU WANT ANOTHER LOAN (Y/N) ";Y$
360 IF Y$ = "Y" THEN 40
370 END
380 REM
390 REM PRINT USING SUBROUTINE"
400 IF D = 0 THEN 510
410 L = LEN (X$):L1 = L - D: IF L1 < = 0 THEN L1 = 1: GOTO 430
420 IF MID$(X$,L1,1) = "." THEN 510
430 DC = 0:DP$ = "N"
440 FOR K = L TO L1 STEP - 1
450 IF MID$(X$,K,1) = "." THEN DP$ = "Y"
460 IF DP$ = "N" THEN DC = DC + 1
470 NEXT
480 IF DP$ = "N" THEN DC = 0
490 IF DC = 0 THEN X$ = X$ + "."
500 IF D > DC THEN X$ = X$ + "0":DC = DC + 1: GOTO 500
510 DC = SP - LEN (X$): IF DC < 0 THEN DC = 0
520 PRINT SPC( DC);X$;
530 RETURN

```

```

RUN
ENTER AMOUNT OF LOAN 5000
ENTER THE ANNUAL INTEREST RATE .18
ENTER THE TERM IN YEARS 2
THE MONTHLY PAYMENT IS 249.62

```

NUM	INTEREST	PRINC	PBAL	TOTINT
1	75.00	174.62	4825.38	75.00
2	72.38	177.24	4648.14	147.38
3	69.72	179.90	4468.24	217.10
4	67.02	182.60	4285.64	284.12
5	64.28	185.34	4100.30	348.40
6	61.50	188.12	3912.18	409.90
7	58.68	190.94	3721.24	468.58
8	55.82	193.80	3527.44	524.40
9	52.91	196.71	3330.73	577.31
10	49.96	199.66	3131.07	627.27
11	46.97	202.65	2928.42	674.24
12	43.93	205.69	2722.73	718.17
13	40.84	208.78	2513.95	759.01
14	37.71	211.91	2302.04	796.72
15	34.53	215.09	2086.95	831.25
16	31.30	218.32	1868.63	862.55
17	28.03	221.59	1647.04	890.58
18	24.71	224.91	1422.13	915.29
19	21.33	228.29	1193.84	936.62

```

KEY C TO CONTINUE

```

NUM	INTEREST	PRINC	PBAL	TOTINT
20	17.91	231.71	962.13	954.53
21	14.43	235.19	726.94	968.96
22	10.90	238.72	488.22	979.86
23	7.32	242.30	245.92	987.18
24	3.69	245.92	0.00	990.87

DO YOU WANT ANOTHER LOAN (Y/N) N

CHARACTER STRINGS FOR FASTER GRAPHICS

by Tom Dempsey

This program was written on the TRS-80, level II 16K using an Okidata Microline 80 printer, which will accept all the character strings from the TRS-80, print in three type sizes, and can be used with the Electric Pencil.

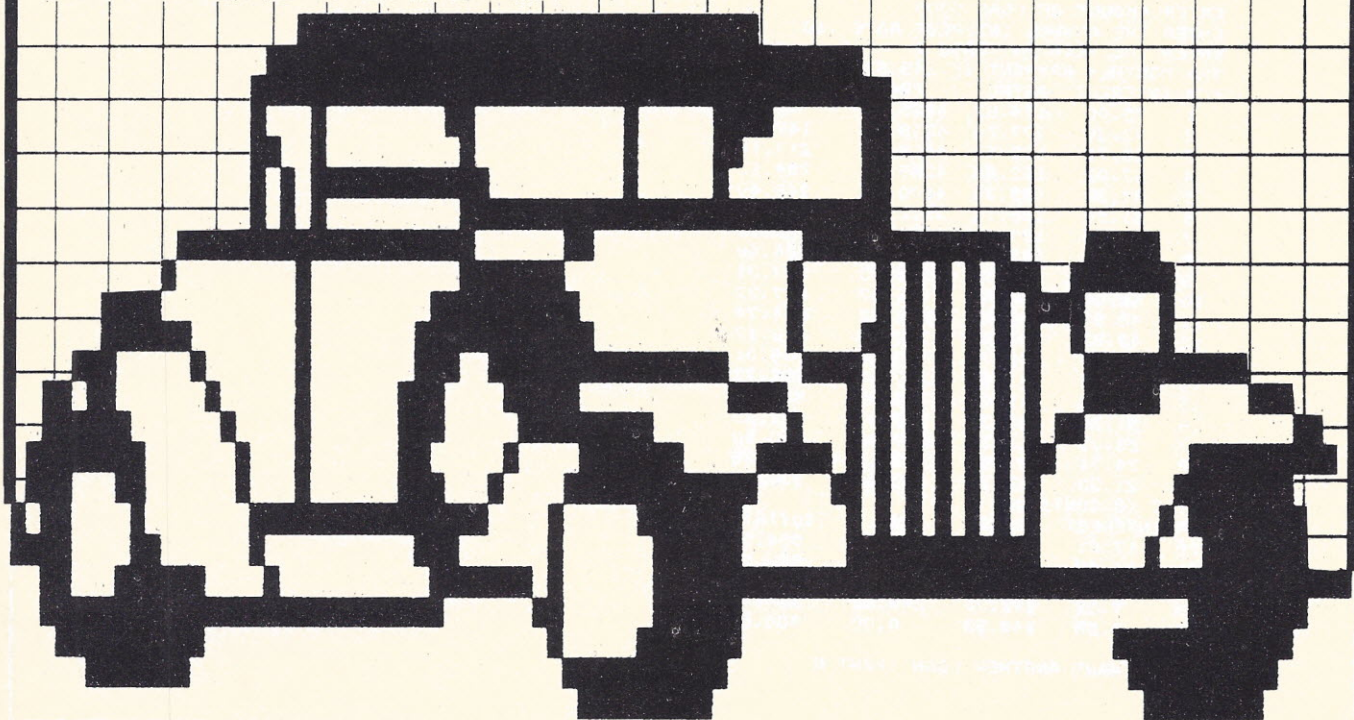
After you have typed out the program and run it, this is what happens. The program starts by going to the printer, setting the printer to print 'chr\$(31)', or large print, and printing the heading—1932 Ford Roadster.

It then initializes the character strings and prints them on the screen in their proper place. Let it proceed into the display phase, which stops the action on the screen and scans all the X, Y points a line at a time. If the point is off, P\$=null; if the point is on, P\$=chr\$(191) or whatever you want it to print. If the printer line spacing was smaller, you have it print (periods) for the picture.

It prints whatever P\$ equals until it runs out of Ys to go get. It runs into line 360, which tells the printer that it had better change its type size, line spacing, and line length so the listing looks good.

It lists the program to the printer, and ends the run, because we did not give it any more instructions. □

—1932 FORD ROADSTER—



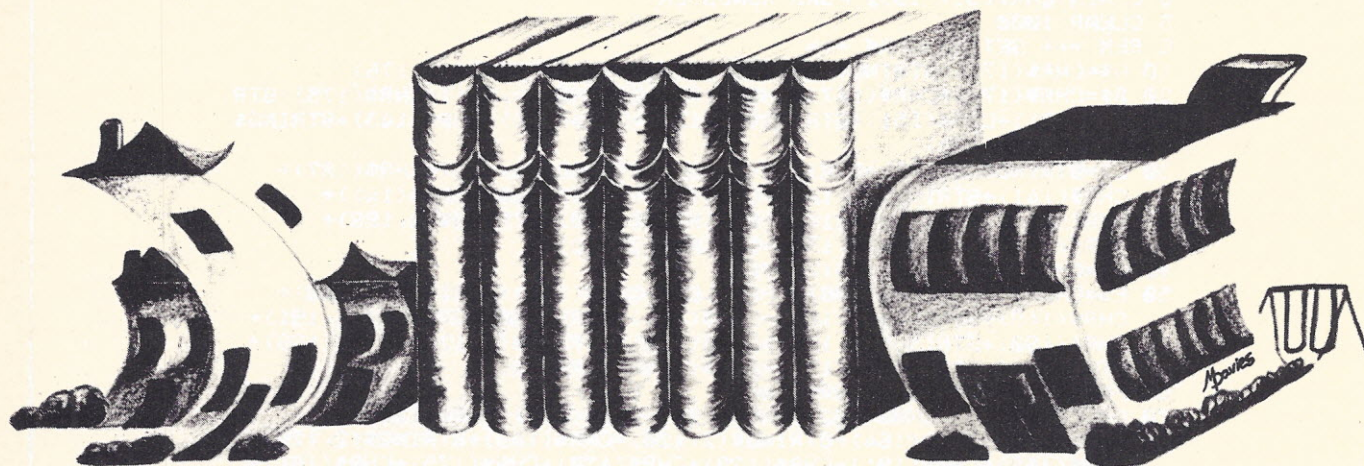
PROGRAM LISTING

```

1 REM *** 1932 FORD ROADSTER ***
2 REM *** WRITTEN BY TOM DEMPSEY : APRIL 10, 1980
3 LPRINTCHR$(31)"1932 FORD ROADSTER"
5 CLEAR 1000
6 REM *** SET UP CHR$ ***
10 A$=CHR$(176)+STRING$(15,188)+CHR$(180)+STRING$(3,176)
20 B$=CHR$(170)+CHR$(147)+CHR$(171)+STRING$(4,131)+CHR$(175)+STR
ING$(5,131)+CHR$(151)+STRING$(2,131)+CHR$(191)+CHR$(143)+STRING$
(3,131)+CHR$(191)
30 C$=STRING$(2,176)+STRING$(3,186)+STRING$(4,179)+CHR$(187)+
CHR$(141)+STRING$(2,140)+CHR$(188)+CHR$(140)+CHR$(141)+
STRING$(2,140)+CHR$(141)+STRING$(2,140)+STRING$(2,188)+
CHR$(191)+STRING$(4,176)+STRING$(2,128)
40 D$=CHR$(160)+STRING$(2,176)
50 E$=CHR$(168)+CHR$(189)+CHR$(182)+CHR$(144)+STRING$(3,128)+
CHR$(149)+STRING$(3,128)+CHR$(184)+CHR$(190)+STRING$(3,191)+
CHR$(180)+STRING$(5,128)+CHR$(170)+STRING$(2,128)+CHR$(186)+
STRING$(4,170)+CHR$(171)+CHR$(140)+CHR$(151)
60 F$=STRING$(2,131)+CHR$(149)
70 G$=CHR$(168)+CHR$(182)+CHR$(191)+CHR$(144)+CHR$(128)+
CHR$(130)+CHR$(164)+STRING$(2,128)+CHR$(149)+STRING$(2,128)+
CHR$(168)+CHR$(191)+CHR$(129)+CHR$(130)+CHR$(175)+CHR$(191)+
CHR$(183)+STRING$(2,179)+STRING$(2,131)
80 H$=CHR$(137)+CHR$(140)+CHR$(164)+CHR$(131)+CHR$(171)+
STRING$(6,170)+CHR$(160)+CHR$(154)+STRING$(2,143)+STRING$(3,1
31)+CHR$(140)+CHR$(164)+CHR$(144)
90 I$=CHR$(160)+CHR$(175)+CHR$(151)+CHR$(131)+CHR$(175)+STRING$
(3,128)+CHR$(165)+CHR$(176)+CHR$(181)+STRING$(2,176)+CHR$(186
)+CHR$(189)+CHR$(176)+CHR$(152)+CHR$(129)+CHR$(160)+CHR$(142)
+CHR$(143)+CHR$(175)+CHR$(191)+STRING$(2,188)
100 J$=CHR$(134)+STRING$(2,131)+CHR$(174)+STRING$(6,170)+CHR$(12
9)+STRING$(3,128)+CHR$(152)+STRING$(3,191)+CHR$(183)+CHR$(13
1)
110 K$=CHR$(130)+CHR$(171)+CHR$(181)+CHR$(176)+CHR$(190)+CHR$(18
9)+CHR$(188)+CHR$(176)+CHR$(178)+CHR$(180)+STRING$(4,176)+
CHR$(187)+CHR$(141)+STRING$(2,140)+CHR$(186)+STRING$(3,128)+
STRING$(3,191)+STRING$(3,140)+CHR$(142)
120 L$=STRING$(6,143)+STRING$(3,140)+CHR$(142)+CHR$(140)+CHR$(19
0)+STRING$(3,191)+STRING$(2,140)
130 M$=CHR$(131)+STRING$(3,143)+CHR$(135)+STRING$(11,128)+CHR$(1
30)+CHR$(172)+CHR$(188)+CHR$(190)+STRING$(2,191)+CHR$(135)+
STRING$(12,128)+CHR$(130)+CHR$(175)+STRING$(3,191)+CHR$(159)
+CHR$(129)
140 CLS
145 REM *** PRINT PICTURE ***
150 PRINT@211,A$;
160 PRINT@274,B$;
170 PRINT@336,C$;
180 PRINT@366,D$;
190 PRINT@397,E$;
200 PRINT@431,F$;
210 PRINT@459,G$;
220 PRINT@482,H$;
230 PRINT@522,I$;
240 PRINT@547,J$;
250 PRINT@586,K$;
260 PRINT@615,L$;
270 PRINT@652,M$;
275 REM *** SUBROUTINE SCAN SCREEN AND LPRINT ***
280 CLEAR 1000:LPRINTCHR$(29):LPRINTCHR$(27);CHR$(56)
290 FOR Y=0TO47
300 P$=""
310 FOR X=0TO127
320 IF POINT(X,Y)THEN P$=P$+CHR$(191)ELSE P$=P$+" "
330 NEXT X
340 LPRINT P$
350 NEXT Y
355 REM *** ADJ. PRINT SIZE & PRINT LISTING ***
360 LPRINTCHR$(30):LPRINTCHR$(27);CHR$(54):LPRINTCHR$(27);CHR$(6
6):LLIST

```

Information Source for Home and School



by Keith N. Schlarb

If you've ever suffered the "Now I wish I could find the article on..." syndrome, you're accustomed to the frantic search through the index pages of every magazine you own. The manual shuffling of magazines is better left to folks at the newsstand.

The storing and retrieving of article sources are excellent applications for a computer. A program used to rapidly locate information sources, such as magazines, books, and pamphlets, benefits the student who needs help locating sources of information for term papers. The computer gives him a rapid search of material, and a chance to use a new technology in library science. With home and school uses in mind, it seemed worthwhile to develop such a program.

I have seen programs manipulate data such as that required to locate an article, but most used an unfamiliar system. Rather than rewrite these programs, I modified one designed to store questions on science articles.

The program was written using Applesoft and a 48K Apple II Plus with a disk system. The files allow for the storage of a subject, author, and title for 950 articles—nearly a full disk with DOS 3.2.

The random access method is used, so a constant length for each file is required. Subject and author data may be up to 20 characters. The allowable length for the title is 55. The length of each is checked by the program immediately after input. If the length is longer than allowed, you are given instructions to reenter it in a shortened form. If this were not done, data would be lost if it exceeded the allowable length of the file.

The information is entered as shown in figure 1. The last number entered in each case refers to the record location on the disk. The record location is used to retrieve any desired data from the disk.

Once data entry is completed, try out the system. A search of any one of the three files, subject, author, or title, may be done using any number of characters. For example, if a search is desired for articles dealing with music, a 5-character subject search is done. The result

SUBJECT ENTRY FORM: MUSIC/145

AUTHOR ENTRY FORM: JONES/145

TITLE ENTRY FORM: DISK INFORMATION/MAY'89/65/145

subject record number

author record number

title article date page number record number

Figure 1. Data entry.

is shown in the partial run of figure 2. Any music article is printed on the screen. The record numbers after the subject are used to retrieve the titles. Suppose, however, you're not sure what subjects identify an article. In this case, a 1-character search locates all subjects

THERE ARE PRESENTLY 235 ARTICLES ON THIS DISK.

THE DATE OF THE MOST CURRENT ARTICLE IS

YOU HAVE THREE OPTIONS

- 1.INPUT INFORMATION
- 2.OUTPUT INFORMATION
- 3.STOP WORK

WHAT IS YOUR CHOICE
ENTER YOUR CHOICE 2

1. SEARCH BY SUBJECT,AUTHOR,OR TITLE
2. RECEIVE SUBJECT,AUTHOR,TITLE FOR SPECIFIC ID.# 1

?DO YOU WANT TO SEARCH BY SUBJECT (1)
AUTHOR (2) OR TITLE (3) 1

?HOW MANY LETTERS DO YOU WISH TO USE
IN THE SUBJECT SEARCH 5

WHAT ARE THE FIRST 5 LETTERS YOU
WISH TO USE IN THE SUBJECT SEARCH

MUSIC

MUSIC RECORDS/9

MUSIC/15

MUSIC/46

MUSIC EQUIP/65

MUSIC APPLE/156

MUSIC/196

MUSIC/197

MUSIC APPLE/198

Figure 2. Search run with 5 characters.

THERE ARE PRESENTLY 235 ARTICLES ON THIS DISK.

THE DATE OF THE MOST CURRENT ARTICLE IS

YOU HAVE THREE OPTIONS

- 1.INPUT INFORMATION
- 2.OUTPUT INFORMATION
- 3.STOP WORK

WHAT IS YOUR CHOICE
ENTER YOUR CHOICE 2

1. SEARCH BY SUBJECT,AUTHOR,OR TITLE
2. RECEIVE SUBJECT,AUTHOR,TITLE FOR SPECIFIC ID.# 1

?DO YOU WANT TO SEARCH BY SUBJECT (1)
AUTHOR (2) OR TITLE (3) 1

?HOW MANY LETTERS DO YOU WISH TO USE
IN THE SUBJECT SEARCH 1

WHAT IS THE FIRST 1 LETTER YOU
WISH TO USE IN THE SUBJECT SEARCH D

DISK EVALUATION/7

DIFFERENTIAL EQ./17

DISK FILES/22

DISK APPLE/27

DATA MANAGE/28

DATA FILES/29

DATA BASE/30

DATA/32

Figure 3. 1-character search run.

starting with a given letter (figure 3). Searches for authors or titles are similar.

Some possible alterations to the program may include adding printer options for the searches, and include provisions for printing the complete lists of the three files. Some may want to have the results of the searches alphabetized before screening. □

Program on page 138

Reclaim: Lifeboat's Software Fix for Disk Surfaces

by Alan R. Miller

The CP/M operating system can be used with almost any kind of 8080 or Z-80 hardware. There are software interface routines to take care of the details needed to transfer data between the CPU and the peripherals such as console, printer, and disks. As a consequence, it is possible to utilize both hard disks and floppy disks on the same computer.

Floppy disks come in two sizes: 8 inch and 5 inch. Both are partitioned into concentric tracks that are further divided into wedge-shaped sectors. The 8-in. floppies are commonly formatted with 77 tracks each containing 26 sectors. There are several types of 5-in. floppies. Some have 10 sectors per track, others have more. A hard disk can store considerably more data than a floppy because it has more tracks and more sectors per track. But, unfortunately, the hard-disk medium cannot be removed; backup copies must be made on another medium.

Information is stored on any disk in an encoded form using a cyclical redundancy check. With this scheme, it is possible for the computer to check the integrity of the data as it is read back. If the computer cannot correctly read a particular sector, the CP/M operating system prints the error message:

BDOS ERROR ON X: BAD SECTOR

where X: is the name of the disk drive. This may startle the computer operator: the read back aborts and systems operations stop. Typing a control-C may return control to the system level, but the error message may simply print again.

If the user has systematically made backup copies of all files on the defective disk, there may be no problem in recovering the data. For example, with the Word Master editor, the user frequently can interrupt

the entering of data by pressing the 'escape' key. The command:

```
*B#WC:PAYROLL.BAS
```

moves the cursor to the beginning of the file and creates a backup copy called 'payroll.bas' on drive C. The simple command of 'and H' will also make a backup copy of the current file. However, this will be stored on the same disk as the primary copy.

If a backup copy cannot be found, it may be possible to recover a file from the defective disk. One method is to copy the file to another disk with the CP/M utility program PIP. Alternately, the file can be saved onto another disk by giving the CP/M 'save' command. With the system debugger DDT or SID, the command might be:

```
A>SID B:NEEDED.FIL
```

```
#^C
```

```
A>SAVE XX NEEDED.FIL
```

where XX is the decimal number of 256-byte blocks in the file. Unfortunately, PIP, SID or DDT may also display the 'bad sector' error message. The file will not be copied in this case.

Separate from the recovery of data stored on the disk is recovery of the disk surface itself. The sector causing the problem may be defective because it has been incorrectly written. In this case, the problem is solved by reformatting the entire disk. There should be a CP/M program called Format for this purpose. Alternately, there may be a program called Copy. This will not only format a disk, but will also copy the entire contents, including the system tracks and directory from one disk to another. If either of these programs can be successfully executed, the disk can be used again.

However, the 'bad sector' message may be displayed during execution of Format or Copy. This suggests that there is actual physical damage to the disk surface that cannot be repaired by reformatting the disk. If floppies are involved, it is easier to throw away the disk. If it's a hard disk unit, this is not very practical.

Another approach is to run a program designed to inspect each sector of the disk. When a defective sector is located, it can be assigned to a dummy filename. Then, subsequent read and write operations to other regions of the disk will not be affected. Of course, if the defective region is in the system or directory area of the disk, there may be no hope. One difficulty with this approach is that disk access under CP/M is made through a filename rather than a particular sector. Consequently, the programming will have to be unusual.

Expanded use of CP/M

A computer program for finding disk errors (IA Sep 80) uses the CP/M BIOS rather than BDOS for reading the disks. It is designed to operate with the standard 8-in. floppy disk and will not work with 5-in. floppies or hard disks.

Lifeboat Associates (New York, NY) initially adapted CP/M to the North Star floppy disk, and has now expanded to include almost every possible type of 8080 or Z-80 microcomputer. Lifeboat has always included easy-to-use systems programs such as Format and Copy with its CP/M. In addition, it acts as agents for a variety of other software houses, offering Pascal, Basic, Fortran, etc.

Lifeboat is now offering Reclaim, which finds defective sectors on any type of disk. It can only be used with CP/M version 2. If defective sectors are found, they are designed as a dummy file. The disk is thus restored to usefulness.

The program is executed by typing 'Reclaim' and the name of the drive to be tested. In addition, the user selects one of three different tests. One option is a read-only test that will not alter data already present. Execution time was 40 seconds with a 4-MHz Z-80 CPU and North Star floppy disks. Two, more thorough, tests are provided, which write patterns on the disk, read them back, and take a little longer to run.

If a defective sector is found, the appropriate error message is given. At the conclusion, the disk is proclaimed to be perfect or, alternately, the number of defective blocks is given. Bad sectors in the data area are assigned to the filename 'Badseca.xxx', designated

as a read-only system file in user area 15. In this case, the file is nearly invisible. The filename will not appear in a listing generated by DIR from any of the 16 user areas. It will appear in a 'stat' listing only when the user area is zero. But the command:

STATUSR:

given at any time will show that user area 15 is active.

The 'Badseca.xxx' filename can be viewed with a little effort. Load

A>DDT STAT.COM

and then return to the system with a control-C command. Change to user area 15 and save 'stat' with

A>USER 15

A>SAVE 20 STAT.COM

Now the command:

A>STAT *.*

will produce a listing giving the name of the dummy file entry. At this point, erase 'stat' and return to user area 0:

A>ERA STAT.COM

A>USER 0

The first thing this reviewer did with Reclaim was get out a stack of diskettes that were put away separately. These diskettes were placed backwards in their dust covers to indicate that something was wrong. Reclaim reported that some of these diskettes were perfect. But it found one or more defective areas for others. One diskette was found to be defective in the system region and had to be discarded. Files named 'Badseca.xxx' were produced on the others.

The next step was to reformat the defective disks by using the program Copy. All but one of the diskettes was successfully reformatted. That one was then restored to service by using Reclaim. The others were also retested by Reclaim and the results indicated that the diskettes were perfect. Several diskettes, however, repeated their previous flaky behavior. For example, all the files on the system disk were successfully copied to a suspicious diskette. The file protection was changed to read-write for all of the files, and this status was confirmed by 'stat'. But then the command:

A>ERA *.*

produced an error message indicating that the disk was write protected. This experience perfectly demonstrates the meaning of the word flaky. □

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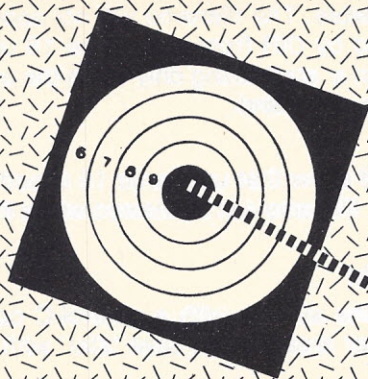
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CIRCLE INQUIRY NO. 2



Trouble-shooting Receivables for the Beginner



by Jim Schreier

Accounts receivable, like payroll, can be difficult to automate successfully. Even simple oversights cause customer confusion. And confused customers don't pay their

bills. Before the computer causes accounts to be charged-off to bad debts, let's explore the quicksands of automated receivables.

If you indicate invoices past due that, when collection is initiated, are

shown by the customer to be paid, you have a problem. Since many local and state governmental organizations hold an unpaid invoice "open" a given period of months, your failure to identify such an unpaid invoice may make collection impossible because of statute. These and other examples make trouble-shooting of receivables necessary.

To begin, we are assuming your receivable program is up and running. Entering data (usually through a cross-checking batch system) is made on a regular basis with a close out, say, on the last working day of the month. Before statements are generated, an end-of-the-month working copy of the receivable ledger is run. This is like a thermometer. Credit memos in the debit (charge) column, invoices in the credit (payment) column, payments not referencing specific invoices, short or over payments or credit memos taken twice are signs something is wrong.

A sample ledger is shown in figures 1 and 2. Figure 1 shows the ledger in balance. It would be simple

ACCOUNTS RECEIVABLE LEDGER MARCH 31, 1981				
DESCRIPTION	SOURCE	DEBIT	CREDIT	BALANCE
*BOB'S SERVICE 566-7788				
INVOICE	12334	25.34		
INVOICE	12337	102.00		
PAYMENT 223	12334		25.34	
PAYMENT 223	12337		102.00	
		-----	-----	-----
		127.34	127.34	** 0.00
*BUHLD INDUSTRIES 567-0987				
INVOICE	12660	875.90		
INVOICE	12699	45.75		
CREDIT MEMO 843	12660		15.82	
PAYMENT 432	12699		45.75	
INVOICE	13044	23.98		
		-----	-----	-----
		945.63	61.57	** 884.06

Figure 1: Accounts receivable ledger in balance.

ACCOUNTS RECEIVABLE LEDGER
MARCH 31, 1981

DESCRIPTION	SOURCE	DEBIT	CREDIT	BALANCE
*BOB'S SERVICE 566-7788				
INVOICE	12334	25.34		
INVOICE	12337	102.00		
PAYMENT 223			50.00	
		-----	-----	-----
		127.34	50.00	** 77.34
*BUHLD INDUSTRIES 567-0987				
INVOICE	12660	875.90		
INVOICE	12699	45.75		
CREDIT MEMO 843		15.82		
PAYMENT 432			40.12	
INVOICE	13044	23.98		
		-----	-----	-----
		961.45	40.12	** 921.33

Figure 2: Accounts receivable ledger with potential problems. Trouble-shooting is important.

to reconcile any customer service problems. Figure 2, however, shows unknown and short payments and a possibly misapplied credit memo. This ledger is in trouble.

Problems with receivables may be traced to either the misapplication of the payments or credits to the account. Trouble-shooting receivables will allow you to identify and, if it is not too late, begin to correct accounts.

There are two ways in which accounts receivable software may apply payments to a customer's account: First, the program applies the payment against the oldest outstanding invoices; second, the operator manually applies the payment against a specific, predetermined invoice. Both solutions have problems. Successful receivable trouble-shooting, however, must start with the correct payment application.

If you have a very small receivable, the first option may work. It sounds tempting. One of the reasons for automating, of course, is to save time while improving productivity. But an automatic payment application will almost guarantee your losing control. For example, you may charge a finance or service charge. Some customers and government agencies ignore service charges. Yet the program will cheerfully apply the customer's

payment to a service charge which, by now, has just been emptied out of the wastebasket. Within a few months, a speedy account reconciliation is out of the question.

The second option, especially for volume customers with hundreds of invoice transactions each month, may seem self-defeating. Yet the

problem with this approach is not the time involved; it is having the customer break down the exact invoice number and amount being paid. Many customers detail their payments. Those who do not, however, can cause problems, especially when you must force (or worse guess at) the application. Later, the customer must be contacted to see if your application is satisfactory. Figure 1 shows each payment posted against the exact invoice by references used in the source column. This approach allows a fast analysis and pinpoints problem invoices often billed to the wrong account.

It is not always possible to make an immediate contact with the customer when questions on what invoices were paid arise. This is usually the case when the current month's statements are up against a strict time schedule. Undetermined payments may still be posted to an account without losing control if sufficient information is maintained on the ledger.

There are three groups: 1) defined payments, 2) short payments (or underpayments) and 3) over payments. Defined payments are directly applied against the invoice. This, of course, is the normal procedure. Since short payments and over payments may be either iden-

DEFINED PAYMENT			
DESCRIPTION	SOURCE	DEBIT	CREDIT
INVOICE	12345	12.50	
PAYMENT 123	12345		12.50
SHORT PAYMENTS			
DESCRIPTION	SOURCE	DEBIT	CREDIT
INVOICE	23456	49.99	
(-- identified --)			
PAYMENT 23456	123 (R)		10.00
(-- not identified --)			
PAYMENT	123 (R)		22.50
OVERPAYMENTS			
DESCRIPTION	SOURCE	DEBIT	CREDIT
INVOICE	9876	49.99	
(-- identified --)			
PAYMENT 9876	456 (R)		59.99
(-- not identified --)			
PAYMENT 456			59.99

Figure 3: Possible application of different types of payments in order to maintain receivable ledger control.

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tifiable or non-identifiable, it is important that these payments be handled with care.

Figure 2 shows how to apply each of the three types of payments so ledger control is maintained. The defined payment example identifies both the invoice and payment in the source column. The software updates the two items and removes them as paid after statements are run.

Handling short payments

Identified short payments reference the invoice number in the description column. The source column contains the receipt number followed by (R). Since receipts are not generally shown, the (R) identifies the difference. When the ledger is updated after statements, the invoice and short payment references do not match. They will not be zeroed out and will remain on the new month's ledger. Until manually altered, a record is maintained of the short payment, the invoice involved and the receipt number involved.

Unidentified short payments cannot, of course, identify an invoice number; however, the payment can still be referenced in the source column. Again, no match between invoice and payment can occur. The account must be manually altered.

Over payments are handled in a similar manner. A \$10 over payment would normally go against the oldest outstanding invoice. This may not be how the customer wants the over payment applied. By referencing the payment and invoice involved in the description column and the receipt followed by (R) in the source column, a record of the exact transaction is maintained. If the over payment is not identified, the receipt number may return to the description column and the source column left blank. The transaction may be treated similar to a credit memo.

Credits may be more complex than payments. There are two types: adjustments and credit memos. Adjustments are usually in-house and not forwarded to the customer. A minor overpayment/underpayment of the account may be handled by an adjustment. So may be a reversal of finance charges. Credit memos are used for merchandise or customer service alterations, a copy of which goes to

the customer. Common uses of the credit memo would be refunding sales tax to a resale customer, an alteration of merchandise or service charges or a refund of damaged or unwanted merchandise.

Many account receivable programs allow the credit memo to be deducted from the oldest outstanding invoice. This cannot be allowed to happen. In order to maintain control, the credit memo must reference the original invoice and be applied against that invoice. This becomes impossible, of course, when a past payment has wiped out the original invoice. In this case, the credit memo should be allowed to remain until the customer removes it from his next billing.

One of the most perplexing problems with automated receivables is the habit of customers taking credit memos twice. Prevention, in this case, is worth a pound of cure. The complexity of the situation is explaining to the customer what happened. It is surprising how many customers do not understand and refuse to repay the credit memo.

Taking credit memos twice usually occurs when the customer deducts a real or imaginary credit in the current calendar month from his check. The credit is given on the next statement. Instead of paying by invoice, the customer elects to pay the statement balance. The credit is taken twice. This may be prevented by manually removing the credit memo when it is first taken by the customer.

Credit memo snags

Figure 2 shows credit memo 843 in the debit column. One of two problems are indicated. Either the operator has entered the credit memo as a debit (thus throwing the receivables out-of-balance) or a credit memo has been taken twice. Research will give the answer. If the credit memo has been taken twice, the description column should be altered to that effect.

Some of the ideas presented here can help keep a new accounts receivable program clean, in line and reconciled with the customer's records. An up-and-running accounts receivable system may need research and numerous adjustments to bring it into line. The superior information a computerized receivable program can bring to your business makes such an effort worthwhile. □

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CIRCLE INQUIRY NO. 47

NEW PRODUCTS

Colorgraphics printer designed for MIS applications is programmable in Pascal or assembler language. The model 4100 produces color business graphics in eight solid colors (yellow, red, orange, blue, green, purple, brown and black). The unit prints on plain paper, printing all colors in a single pass and switches quickly between graphics



and alphanumeric modes. Current resolution is 68 dots per linear inch, horizontal or vertical, and speed in the color graphics mode averages 3 minutes a page for 11-inch forms. Characters are printed in a 5 by 7 dot matrix at a rate of 60 lines per minute. Applications include financial reporting, presentations, proposals, program time-tables and sales reporting. Ramtek Corp., 2211 Lawson Lane, Santa Clara, CA 95050, (408) 988-2211.

CIRCLE INQUIRY NO. 121

Desktop computer system features graphics computation and is capable of displaying results in up to 4913 colors on a CRT display. The HP series 9800 system 45C constitutes a complete workstation—built-in color-graphics CRT display, light pen, operating system, read/write memory, enhanced-Basic language, keyboard, mass storage system, and thermal line printer—integrated into a single desktop unit. The system's tri-color, shadow-mask CRT displays clear colors



across the 560 by 455 pixel display. Geometric figures are drawn on the CRT through simple commands. An additional 'fill' parameter quickly adds color fill to any of the drawn figures. The system provides individual access to its three memory planes and assignment of the red, green, and blue color guns to these planes in any Boolean combination. Standard, 187 K-byte system price: \$39,500, 56 K-byte version price: \$31,500. Hewlett-Packard Co., 1507 Page Mill Rd., Palo Alto, CA 94304, (415) 857-1501.

CIRCLE INQUIRY NO. 122

Plug in board provides graphics capability for Texas Instrument's Omni-810 RO printer. The user may choose two plot modes for raster scanning and may define his own 75 character software font for custom uses. Standard 810 Ascii performance and 150 cps speed are retained. Data is received on the standard RS232 serial or other parallel interface at rates to 9600 baud. The board plugs into the option card slots and no electrical or mechanical modes are required. Board self test is initiated by the 810 front panel test switch. Analog Technology Corp., 15859 E. Edna Place, Irwindale, CA 91706, (213) 960-4004.

CIRCLE INQUIRY NO. 123

Turnkey graphics system, IGS 500, is adding models 400 and 300. These two models are single workstation systems that support data bases that accommodate both graphic and non-graphic information and an English-like command language. The systems can support all IGS applications programs, including design and drafting, piping and mapping. The IGS 400 starts off with a 64K word system processor, a 50 M-byte disk



drive, floppy disk subsystem with 128KW (16 bit word) capacity and user workstation. The IGS 300 is a satellite system that links to a central unit for transmitting drawing files. This model is similar to the 400, except that it is supported with a synchronous communication line instead of floppy disks. Price of model 400 is \$89,000 and the model 300 begins at \$85,000. Calcomp, 2411 W. La Palma Ave., Anaheim, CA 92801, (714) 821-2541.

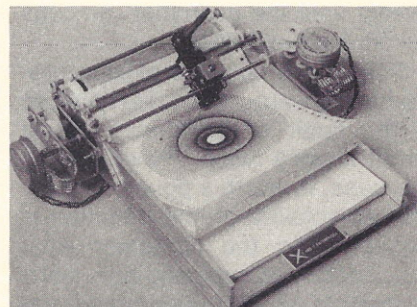
CIRCLE INQUIRY NO. 124

Graphics processor for the TRS-80, Auto-Graph, is capable of creating graphics in either "canned" chart format or free-form "drawing" mode. Graphics created may be saved to disk or tape. The graphics can be printed on either Centronics compatible dot matrix or high resolution daisywheel printers. In the canned chart mode predefined graphs such as bar, pie and plotted point charts are created from data entered by the user or from information contained in existing data bases. In the free-form mode, any drawing created on the screen may be printed. Since it is capable of interacting with the Programma high resolution graphics board it can be used to print out schematic diagrams, Arabic or Japanese characters and other high resolution drawings. Computer Textile,

10960 Wilshire Blvd., Suite 1504, Los Angeles, CA 90024, (213) 477-2196.

CIRCLE INQUIRY NO. 125

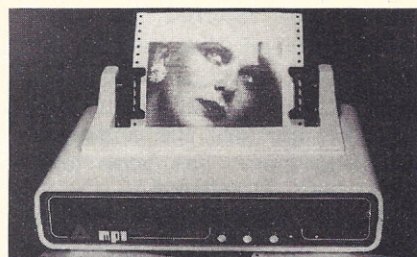
Drum plotter, model 60, can make plots up to 8 inches wide and 144 feet long. Six commands, input via TTL parallel, RS232 or IEEE 488 interface, control the vertical (pen) and horizontal (paper over drum) motions. Sturdy steel/aluminum construction, plus two stepping motors give resolution of .005 in., repeatability of $\pm .0025$ in. and plot speed of



1.5 in./sec. The plotter uses standard, sprocket feed typewriter paper, has a universal pen holder and runs on 110V/220V AC at 50/60 Hz. Model 60 is 16 in. long, 15 in. wide, 6 in. high and weighs 16 lbs. Parallel—\$310, RS232—\$395, IEEE 488—\$410. X and Y Enterprises, P.O. Box 796, Huntsville, AL 35804, (205) 534-0177.

CIRCLE INQUIRY NO. 126

Low cost printer, model 88G, features 100 character per second bidirectional or unidirectional printing with a short line 'quick cancel' feature, giving thruput rates of up to 150 lines per minute. A full upper and lower case 96 character Ascii set is printed in a 7 by 7 matrix with print line formats of 80, 96 or 132 columns per line over an 8 inch print area. Double-wide characters are software

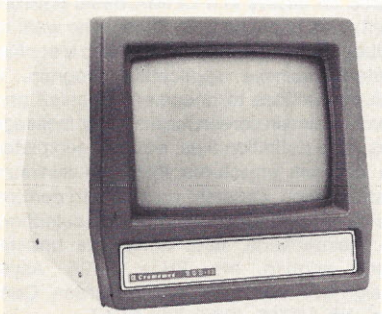


selectable in any of the font styles or character densities and can be intermixed on a line for message high-lighting. A high resolution dot addressable graphics option can be added for applications requiring plotting, printing of screen graphics, drawing of illustrations or producing special characters and identification marks. The microprocessor controlled interface can accept either RS232C data up to 1200 baud or TTL level

parallel data in excess of 1000 characters per second. Price with graphics option: \$799. MPI, 2099 West 2200 South, Salt Lake City, UT 84119, (801) 973-6053.

CIRCLE INQUIRY NO. 127

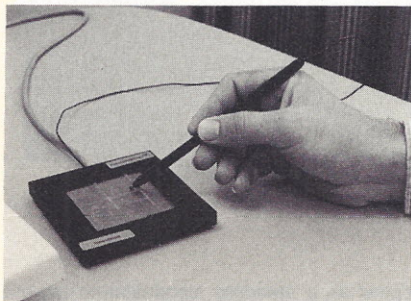
Color monitor, RGB-13, for use with SDI graphics systems displays color or black-and-white images with up to 754 by 482 point resolution. The graphics system and monitor are suited to applications in business, medical imaging, process control, industry, education, computer-aided instruction, science and other professional fields. The system conforms to NTSC standard



RS-170 for applications in the TV industry. The monitor has a fine-pitch 13 in. shadow mask and a high-precision delta-configuration electron gun. The unit is self-converging and features internal magnetic shielding and an implosion protection band. A long-persistence phosphor guarantees a flicker-free screen. Price: \$2,995. Cromemco, Inc., 280 Bernardo Ave., Mountain View, CA 94043, (415) 964-7400.

CIRCLE INQUIRY NO. 128

Graphics input device, Prestodigitizer tablet, allows microcomputer users of all ages to sketch pictures on the display as well as enter data into the computer by printing letters on a special tablet surface. Versions of the tablet are available for computers made by Commodore Business Machines, Apple, and Atari. The same recognition



method that allows the tablet to detect characters is also used to sense the strokes used in creating a picture. By looking at stroke sequence and direction rather than absolute pen position, the cost is kept low. The tablet adapts to each user's individual printing style—making the computer adapt to the user. Price is \$70. Innovision, P.O. Box 1317, Los Altos, CA 94022, (415) 964-2885.

CIRCLE INQUIRY NO. 129

Binary video digitizer for the Apple II is a peripheral board that utilizes a video camera with external sync to load the high resolution page of the Apple II with any image that can be captured with the video camera. The unit was designed as a frame grabber, DMA type, digitizer to require one frame or 1/60th of a

second to capture a binary image. Software is included to build dithered (pseudo gray scale via half tones) images from multiple binary images and to capture image intensity contours using image subtraction. The number of frames required to produce a dithered image is dependent on the dither matrix size. The software supplied allows the user to select and change the matrix size and view the effects on the monitor. The Dithertizer II requires a video camera with external sync. Price: \$300. Computer Station, 12 Crossroads Plaza, Granite City, IL 62040, (618) 452-1860.

CIRCLE INQUIRY NO. 130

Four-color graphics are offered in Visicalc Plus software for the HP-85 personal computer. Graphics programs allow users to turn tables into four-color graphics. Line charts,

bar charts, pie charts, and curve-fitting graphs are available along with versatile graphics features, such as six different styles of lines and hatchings. Also featured are more than 20 functions, including financial, statistical and math functions that include internal rate of return, standard deviation and variance. Price is \$200. Hewlett-Packard Co., 1507 Page Mill Rd., Palo Alto, CA 94304, (415) 857-1501.

CIRCLE INQUIRY NO. 131

Video display terminal, Dialogue 80, is a buffered editing system that operates in either conversational or block mode. The unit has a keyboard with fast repeat-type keys and a numeric pad section. Separate keys control the movement of the switch-selectable cursor that can operate in block or underline, blinking or non-blinking modes.

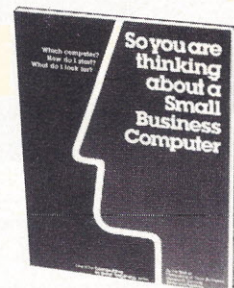
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CIRCLE INQUIRY NO. 12

A 25th display line (switch selectable on/off) allows the user to determine the status of various operational modes and note detected



errors. The terminal has an RS-232C asynchronous interface, which operates up to 19.2KB, half or full duplex, as well as a

standard serial printer interface. The unit has a data format of 24 lines by 80 characters plus a top status line of 80 characters for a total of 2000 displayable positions of the 12-inch diagonal screen. Editing features include: erase, insert and delete character and line functions. Price: \$1,149. Ampex Corp., 401 Broadway, Redwood City, CA 94063, (415) 367-4151.

CIRCLE INQUIRY NO. 132

IEEE S-100 compatible board is capable of simultaneously interfacing several parallel devices, including intelligent hard disks, to the S-100 bus. I² (Intelligent Interface) is capable of running at 4MHz without wait states and has on-board intelligence in the form of a Z80A CPU, plus RAM and a 2716 Eprom that interfaces a device without writing all the software necessary to accomplish the

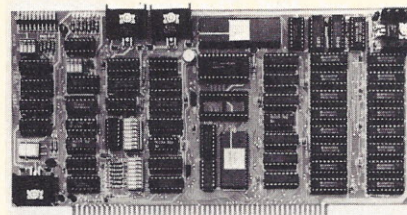
tasks. The unit has four parallel ports with 8 bit handshaking, all under software control, and may interface up to four different hard disk controllers. Applications include an interface to tape backup controllers, floppy disk controllers and a buffered interface for a parallel printer. It performs all I/O transfer operations independent of system time thus freeing the system for parallel processing while printing out hard copy information. Teletex, 9767F Business Park Dr., Sacramento, CA 95827, (916) 361-1777.

CIRCLE INQUIRY NO. 133

Software for application developers operates on micros in a CPM-CBasic environment. This package is for those who want to reduce the time needed to develop a sophisticated business application program. It includes utilities to document CBasic2 programs, maintain screen masks, error message files, data definition files, etc. The templates are program structures that with minimum customization, generate programs to perform the necessary functions of menu selection, file maintenance, data entry, file update, report printing, etc. Price: \$495. Asyst Design Services, 756 Bowling Green, Cortland, NY 13045, (607) 756-8247.

CIRCLE INQUIRY NO. 134

Video board for S-100 computers represents a near-optimum design of a word processing capability combined with graphics. A maximum of 4096 bytes of continuous memory may be directly mapped to the video screen as characters or graphics. The display may be programmed for up to forty-eight 80 character lines featuring upper and lower case letters with true descenders. The VB3 features a second RAM block in addition to the video RAM which contains "attribute" bytes to control the display of each individual character. These allow any character to



appear as a standard alphanumeric upper/lower case font or user-programmed font. The character may also be displayed in normal or low intensity, reverse video as well as added print functions. The video board produces a standard 80 by 24 display or up to 80 by 48 display for a full page of text. It will also display up to 256 user defined symbols and a 160 by 204 matrix for graphics. Software includes a CPM compatible driver routine and a powerful terminal simulator routine. Software controlled options include software controlled timing, top and bottom margins and horizontal position, inverted video, (2 by 4) graphic character, one-level of gray, blinking character, underline, blank-out character and cursor. SSM Microcomputer Products, 2190 Paragon Dr., San Jose, CA 95131, (408) 946-7400.

CIRCLE INQUIRY NO. 135

MICROSETTE

C-10—\$1.00 C-60—\$1.75



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In the amazing microcomputer industry a three-year-old product is a winning product. Microsette users acclaim the excellent value and reliability of these cassette tapes for safe storage of their computer programs. Microsette 50-foot and 100-foot length cassettes are backed by a 30-day warranty for use on all popular microcomputers. The two convenient lengths store the complete memory contents of most microcomputers. The tapes are as excellent for Hi-Fi audio as for microcomputer use.

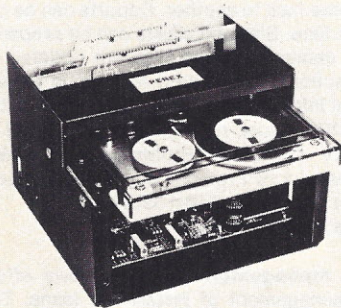
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Microsette Co., 475 Ellis St., Mountain View, CA 94043

Cartridge tape drive for Winchester disk backup, Peristore HD6400, is a 6400-bpi, 1/4-inch cartridge drive that utilizes a 450-foot 3M data cartridge to provide an unformatted storage capability of over 17 M-bytes. It is intended primarily as backup to Winchester technology sealed disk drives with capacities from 5 to 20 M-bytes. Thus, users can back



up an entire Winchester disk on one HD6400 cartridge; and, if a user has more than one Winchester disk in his system, he can back up any number of disks with more cartridges, using one drive. Price: \$1,100 in OEM quantities. Perex, Inc., 1798 Technology Dr., San Jose, CA 95110, (408) 280-7566.

CIRCLE INQUIRY NO. 136

Time sharing security system for use on the AM-100 series computers implements a complete file security system. Users are prevented from accessing files in accounts in which they are not allowed access. Each user is assigned a system access level from 1 to 65500 and various system functions are protected, or can be protected by the user, from unauthorized access. It provides for 27 system calls allowing programs to fetch the operator's name, company name, etc. This information access allows programs to be written that can maintain complete audit trails. The data encryption board is a standard S-100 bus board with fully buffered data, address, and control lines. Data files can be encrypted that can only be decrypted by the board that encrypted the data. This further provides security for sensitive data. Dravac, 150 Fifth Ave., Suite 530, New York, NY 10011, (201) 666-2538.

CIRCLE INQUIRY NO. 137

Dual-purpose printer, Dual-Mode 200, is designed to meet OEM requirements for a single printer that serves in data processing



applications as well as word processing. This is accomplished through a letter quality print mode and associated word processing compatible firmware. Each character font features high speed and reduced speed word processing. Output speeds range from 165 to 250 cps in the data processing mode

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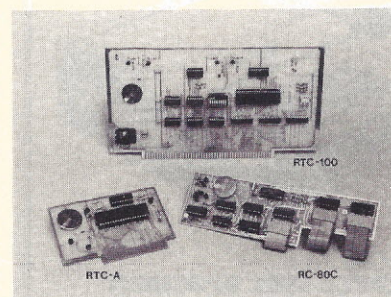
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CIRCLE INQUIRY NO. 54

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CIRCLE INQUIRY NO. 71

and 42 to 60 cps in the letter quality mode, depending on the font selected. The printer is capable of storing up to six different character fonts in ROM with a data processing and a word processing version of each for a total of 12 speed/font options. Complete "dot control" graphics is provided with resolution to 120 horizontal by 144 vertical dots per inch. The universal forms handling permits the use of single sheet and pin-feed paper. Multiple part forms (to 6 parts) are also accommodated. The printer is compatible with a variety of systems. The driver supports existing word processing software with standard daisywheel control sequences. Malibu Electronics Corp., 2301 Townsgate Rd., Westlake Village, CA 91361, (805) 496-1990.

CIRCLE INQUIRY NO. 138

Data base management system, series 20/DBMS, for Z-80 microcomputers is a smaller version of system DBM-1. It contains many of the same features designed for transaction processing applications. Applications can be developed by non-computer people using English-like command language for personnel records, accounting functions, inventory control, or other business reporting requirements. This version uses 19 commands including operations for selecting, sorting, appending, or posting data. Price: \$695. Condor Computer Corp., 3989 Research Park Dr., Ann Arbor, MI 48104, (313) 769-3988.

CIRCLE INQUIRY NO. 139

Text editor for CP/M provides full screen editing with forward and backward scrolling, but is not hardware dependent. It is designed for use with both CRT terminals and video monitors. Commands include forward or backward 'find' and 'change'; and 'insert', 'delete', 'replace', 'append', 'print', 'copy', 'window', 'macro', 'tabset', 'scale', 'dump', and others. 'Locate', 'change', and 'find' commands are saved for easy re-execution. 'Get' and 'put' commands allow files to be concatenated, moved, duplicated, or merged on the same or different diskettes. Compatible with CBasic, MBasic, Fortran, Cobol, and Assembler. Available on a 5 or 8-inch single density diskette for \$99. Software Development and Training, P.O. Box 4511, Huntsville, AL 35802.

CIRCLE INQUIRY NO. 140

Wordbank program for TRS-80 model II provides a facility for writing letters, reports, manuals, or other documents on a one time or repetitive basis. By storing the lines of words or numbers of a document in the computer, the processes of editing and changing, and the production of the document is clean and error free. Features include up to 7500 document lines available; lines may be added, changed, or deleted anywhere in document; user assigned or automatic page control; automatic line numbering; automatic page numbering; user assigns document a unique file name which remains on the disk until user-deleted. Hardware minimum: 64K user RAM, one disk file, line printer. Price: \$149.95. Taranto & Assoc., P.O. Box 6073, 121 B Paul Dr., San Rafael, CA 94903, (415) 472-2670.

CIRCLE INQUIRY NO. 141

Medical billing system, SoftCare, prepares patient bills and insurance claims for up to 30 doctors. Accounts receivable are maintained by patient and insurance company,

and the detail is retained so individual claims can be tracked. Design makes it simple to learn and easy to use, even for a noncomputer operator. The fill-in-the-blank screen formats are practically self-explanatory and extensive error checking takes place as the information is entered. All you need to inquire into a patient file is the patient name—no ID number. Operator can easily branch from one task to another. Reports can be run at any time. Bills and claims can be prepared upon demand. Patient files are updated as transactions are entered so that up-to-date patient information is always available; written in UCSD Pascal; runs on any Z80, 6502 or LSI 11 computer. Professional Business Software, 119 Fremont St., San Francisco, CA 94105, (415) 546-1596.

CIRCLE INQUIRY NO. 142

Loan management system allows effective management of installment loans. The system, designed as a minicomputer based, operator interactive package, will replace the processing that is many times contracted out to a service bureau. Customers are entered into the system via a customer file maintenance routine. Two types of transaction entries are necessary: billing (which includes installments, late charges, and adjustments) and cash payments. Entry and editing programs are used for transaction maintenance and edit lists are printed as "tracks" so that newly entered transactions may be checked prior to posting to the open item file. Carolina Business Computers, Inc., Oakwood Center, 350 Third Ave. NW, Hickory, NC 28601, (704) 322-6005.

CIRCLE INQUIRY NO. 143

Word dictionary system for CP/M users, Wordsearch, provides assurance that written material is produced free of misspelled words. The program is easy to learn and use for searching documents, letters, manuals or any text material for the occurrence of words that have not previously been validated and placed in the main word library. These words are identified as both a list of words or in context of the original text. Words found not to be in the library but identified as valid are added to the library at your command. Usage is simple with the built in default parameter assignments. These defaults can be overridden to achieve the desired result. Word libraries can be easily tailored to handle special vocabulary requirements. The program is distributed on an 8-inch single density diskette with a complete user manual, an initial spelling word dictionary, and a demonstration package for \$195. Key Bits Inc., Box 592293, Miami, FL 33159.

CIRCLE INQUIRY NO. 144

37 circuit design programs contained on seven tapes includes full documentation in easy-to-use and follow format. The software can be used as stand-alone programs or as subroutines for more complex programs. They can be altered easily to meet specific or unique requirements. The series of programs are written for use in the design of active filters, matching pads, attenuators, heat sinks, integrated circuit timers, Zener diode regulators, bipolar transistor circuits. Using the programs, the operator can solve simultaneous equations with real and complex coefficients and polynomial roots. The operator also can determine the effects of an infinitely variable set of design parameters. The pro-

grams are designed for use on TRS-80 systems having level II Basic and at least 16K RAM; however, many of the routines can be adapted to run on the Apple, PET, OSI, and other microcomputers. The software systems tapes include: Plotting Graphs for Video Display, Plotting Graphs for Line Printers, Active Filter Design, Descriptive Statistics and Regression Analysis, Electronics I, Electronics II and Electronics III. Howard W. Sams & Co., Inc., 4300 W. 62nd St., Indianapolis, IN 46206, (317) 298-5400. **CIRCLE INQUIRY NO. 145**

Educational release, Earth Science Series, contains 12 independent programs designed to teach a particular topic covered in junior high or senior high school such as gradient, heat energy lost and gained, latitude and longitude, basic chemistry, steam erosion, water budget, seismic waves, earth history, seasons, meteorology, and percent error. A perfect supplement to a teacher's curriculum or for reference room use. Program turns the computer into an intelligent calculator, preprogrammed with 20 of the most common formulas used in lab experiments. While it helps the student with his calculations, it also reinforces the formulas used. In addition, there is a simple data graphing routine in which a student may create graphs of his lab results. Programs do not require programming knowledge. Twelve programs on four cassettes, teacher/student manual, and a vinyl storage binder, 16K TRS-80, \$59.95 plus \$1.50 postage. T Y C Software, 40 Stuyvesant Manor, Geneseo, NY 14454, (716) 243-3005. **CIRCLE INQUIRY NO. 146**

High-performance microcomputers ranging from a low-end, 32 K-byte RAM OEM system to a fully integrated, 20 M-byte disc-supported system includes multi-tasking operating software. The heart of each system is a Z80A-based CPU. Designed to operate at 4MHz, the CPU provides eight levels of automatic hardware-vectorized interrupt and nesting as well as a limitless number of sublevel polled interrupts. A DMA interrupt structure permits multi-processing with interleaved data transfer rates of up to 2 M-bytes per second. The CPU also includes a real-time clock capable of operating in repetition interrupt or reload modes to 19.2 kilobaud, one of which may also be used in synchronous mode. Memory is available in 16 and 32K static RAM modules, capable of operating in phantom mode for multi-user segmentation, as well as in 64K dynamic RAM with on-board, non-interfering refresh and a 20K ROM module. California Computer Systems, 250 Caribbean Dr., Sunnyvale, CA 94086, (408) 734-5811. **CIRCLE INQUIRY NO. 147**

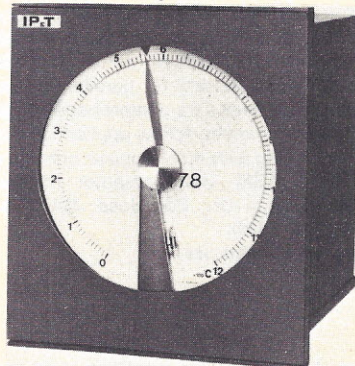
Hard disk drive enclosure is a desktop model in teak finish. Enclosure requires approximately 10 minutes to assemble. The bottom is grooved for sliding controller for ease of access and non-visibility. A clear bronze plexiglass lid opens fully for unhindered access to cartridge. Price: \$130. Electronic Enclosure Enterprises, 4901 Morena Blvd. #325, San Diego, CA 92117, (714) 483-4650. **CIRCLE INQUIRY NO. 148**

Parallel printer interface for the Apple II computer incorporates an easily programmed

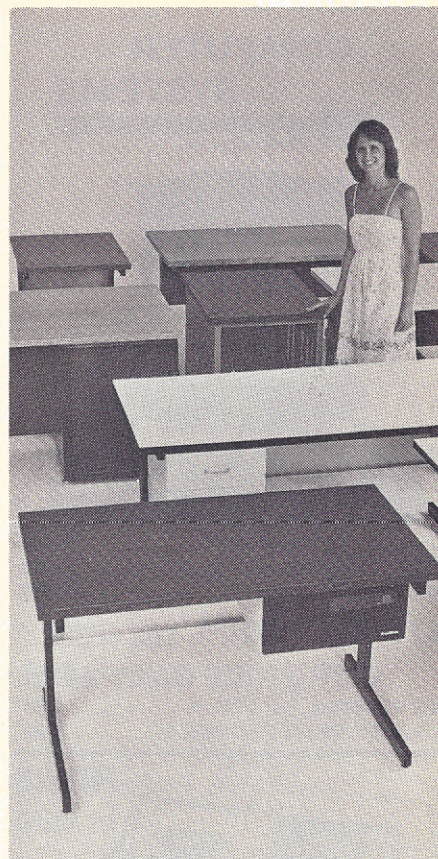
2716 Eprom for holding up to eight different firmware driver programs. These different firmware driver programs are hardware (switch) or software selectable. The unit is totally compatible with all Apple II and Apple II + software that turns the printer on by using the standard Basic call "PR#X" where X is the slot number the printer interface resides. The device supports, under software control, hand shaking with negative or positive going data ready strobes as well as the capability of interrupting the microprocessor in a multi-user environment. This device can also be used as a general purpose 8 bit parallel output port. As such, it can be configured as two ports, each with handshaking with a large prototype area for custom applications. A firmware driver is supplied programmed in a 2716 Eprom that interfaces a Centronics printer to the Apple II or Apple II +. Price: \$220 with a Centronics connector, driver routine and cable. Microproducts, 30420 Via Rivera, Rancho Palos Verdes, CA 90274, (213) 541-5131. **CIRCLE INQUIRY NO. 149**

Fig-Forth for Z-80 microcomputers to run under the CP/M 2.x operating system is fast, easy to use, extensible, and totally flexible. It is supported by a compact run-time package that includes an interpreter, compiler, and assembler. It is ideally suited for the rapid development of real-time data acquisition or process-control applications. Executable interpreter, line editor, screen editor, many utilities and demonstration programs, and full documentation are distributed on an 8-inch soft-sectored, single-density diskette. Price: \$50. includes tax, handling, and shipping by first class mail. Laboratory Microsystems, 4147 Beethoven St., Los Angeles, CA 90066, (213) 390-9292. **CIRCLE INQUIRY NO. 177**

Circular chart recorder model 2131J presents a continuous record of process value on a 9.5 inch (240 mm) diameter rectangular chart of 4 inches (100 mm) calibrated width and is designed for those applications where readability of process information from a distance is of primary importance. Indication is provided against a concentric scale. Standard chart drive speed is one revolution in twenty-four hours with eight-



hour and seven-day options available. A bold pointer indication on a 27.5 inch (700 mm) long concentric scale is provided. Optional features include: upscale or downscale burn-out protection; retransmitting slidewire; a choice of response times and alarms. International Products and Technologies, Inc., 541 Davisville Rd., Willow Grove, PA 19090, (215) 657-3197. **CIRCLE INQUIRY NO. 178**



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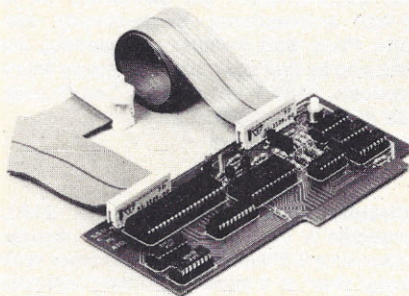
609 Butternut Street
Syracuse, N.Y. 13208
(315) 478-6800

CIRCLE INQUIRY NO. 90

Programming system PL/I-80 version 1.3 includes the ability to compile several external procedures in a single compilation. Features designed to enhance commercial processing include: Picture specifications are included for use as format items for editing data on output, in a 'put edit' command; also, an extensive supplement to the applications guide has been added. It explains the use of PL/I-80 arithmetic in commercial processing, including the use of the data types 'fixed decimal' and 'float binary', and the use of several run-time library subroutines. It also includes library facilities to aid conversion from float binary to fixed decimal arithmetic. Digital Research, Box 579, 801 Lighthouse Ave., Pacific Grove, CA 93950, (408) 649-3896, TWX 910 360 5001.

CIRCLE INQUIRY NO. 179

Serial and parallel interface, AIO, expands the capabilities of the Apple II. The unit can interface with both serial and parallel devices at the same time under Pascal. The RS-232 serial interface has three handshaking lines (RTS, CTS, DED), and eight standard baud rates from 110 to 9600 (including 134.5 baud for selectrics). Additional baud rates are possible through external input and baud rates are rotary switch selectable. The two bi-directional 8-bit parallel ports are provided with four additional interrupt and handshaking lines, as



well as interface configurations that are totally programmable and software controlled. The device includes on-board firmware for controlling serial interface and software for driving parallel printers. Firmware for parallel interface control is also optionally available. In addition, it includes all of the cable assemblies necessary for parallel and serial interfaces as well as a comprehensive users manual with easy-to-follow application notes for interfacing with most popular printers and terminals. SSM Microcomputer Products, 2190 Paragon Dr., San Jose, CA 95131, (408) 946-7400.

CIRCLE INQUIRY NO. 150

Form letter mailing package with image capability for use with daisy or other word processors, comes with simple and easy to use instructions, stores up to 20 items on each individual and retrieves all or part of it for each individualized form letter. It retains files on as many individuals as your disk space allows, even on multiple disks. Elastic use of disk space allows you to enter as much or little information as desired. It also merges multiple lists. New function enables

user to enter data quickly in upper case and transfers it automatically to proper case. State abbreviations are handled automatically with escape for special names. Package consists of seven programs. InfoSoft Systems, 25 Sylvan Rd. S., Westport, CT 06880, (203) 226-8937.

CIRCLE INQUIRY NO. 151

Data factory provides instant accessibility to records and files, which can then be re-arranged into new combinations supplying information in seconds. It is a universal data base management system that can be used at work or at home to set up mailing lists, sales records, accounts payable or receivable, checkbook reconciliation, date reminders and more. The unique feature which sets it apart from all others is its complete modifiability—form a new data base from your old without reentering the data again. Add, delete, replace, rearrange, or compare fields or data at any time. The program is available for one or two disk drives and requires 48K with Applesoft in ROM for \$100. Micro Lab, 811 Stonegate, Highland Park, IL 60035, (312) 433-7877.

CIRCLE INQUIRY NO. 152

Accounts receivable demo package can be supplied on either 8-inch single density or North Star compatible 5 1/4-inch double density diskettes. The package comes complete with system documentation and sample data files. In order to use this package, one should have CP/M, a 24 by 80 CRT which supports cursor controls, a Z80 or 8080 processor, two floppy disk drives, and a 132 character printer. Arkansas Systems, Suite 206, 8901 Kanis Rd., Little Rock, AR 72205, (501) 227-8471.

CIRCLE INQUIRY NO. 153

Applications package for physicians, Medical Office Management, provides an easy to use system which maintains patient general information files, the total office's appointment schedule, maintains and prints the daily transactions log, prints procedure by procedure management reports, prepares and prints private patient bills, and prepares insurance claim forms. Maintains 10,000 active patients and can schedule up to 19,000 current and future appointments, can be expanded to handle multiples of 10,000 active patients in a clinic setting, can provide an appointment horizon as long as 40 months, and handle up to about 190 patients per physician a day with up to 250 transactions. Requires either two or three disk drives, a 130 column printer, and a 48K Apple with either the Language System or Applesoft in ROM. Price: \$359.95. Charles Mann & Assoc., Micro Software Div., 7594 San Remo Trail, Yucca Valley, CA 92284, (714) 365-9718.

CIRCLE INQUIRY NO. 154

Educational authorware for cassette and disk-based TRS-80 permits the instructional developer to concentrate his teaching skills upon the creation of computer assisted instruction while avoiding details and distractions of computer programming. Three levels are available: Caiware featuring text and multiple-choice or fill-in question formats; forward branching; and key-word or alternate answer recognition. Super-Cai includes updating, copying and compressing of existing

lessons, graphics, tutorial/evaluation modes, and student record keeping. MicroGnome, 5843 Montgomery Rd., Elkridge, MD 21227, (301) 796-4165.

CIRCLE INQUIRY NO. 155

8080/280 word processors combine a fast tabular report generator with word processing. The T/Maker system provides easy analysis and presentation of numerical data and text copy used in financial modeling and report preparation. Typical applications include sales projections; profitability studies; balance sheets; estimates and price sheets. It requires a 48K CP/M system and CBasic-2. The system includes a full screen editor for word processing and report generation. A special macro command allows any series of keystrokes to be saved and executed with one keystroke. Text insert delete, global search and replace, and block move are all supported by the editor. Computation for rows and columns includes: standard arithmetic, percents, exponents, common transcendental functions, averages, maxima, minima, and projections. With its unique visual two-dimensional syntax for computing tables, and other features, creating, modifying and restructuring tables becomes as easy as entering the data. Files can be inserted, appended, and sorted. Data files can be created, loaded, and processed automatically. Price: \$275. Lifeboat Assoc., 1651 Third Ave., New York, NY 10028, (212) 860-0300, telex 220501.

CIRCLE INQUIRY NO. 156

Disk operating system for the Apple II, Apex, provides the user with a complete program development and file management system. A comprehensive command set allows the user to perform almost any imaginable disk operation, yet a powerful default structure eliminates the typing of frequently used file names and complex command strings. The basic package includes all of the necessary tools for a complete assembly language development system. The package includes a high speed two pass resident assembler and a powerful macro editor. The assembler generates an alphabetized symbol table, a cross reference table and is capable of assembling over 1900 lines per minute. The editor has 18 commands, 10 text buffers and is completely capable of performing the most complex editing tasks. The complete package comes with operating system, assembler, editor and nearly 200 pages of comprehensive documentation for only \$99. Apparat, Inc., 4401 S. Tamarac Parkway, Denver, CO 80237, (303) 741-1778.

CIRCLE INQUIRY NO. 157

Desktop computer system allows the user to configure it with two 8-inch floppy disk drives, two or three 5-inch disk drives or a 5-inch 6-megabyte Winchester with 2 megabytes of removable storage. 64K of RAM is standard with expansion to 256K, a 1K Eprom monitor provides system test functions and auto-boot of CP/M, and up to 8K of Eprom is available. Keyboard features include a numeric pad, cursor controls, and 20 function keys, with N-key rollover. The video unit features an 80 by 24 standard display with programmable formats, programmable character sets, graphics, reverse video, blink, underline, and multiple intensities by fields.

FEBRUARY 1981

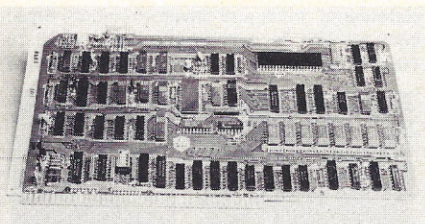
Data World Inc., 7541 Ravensridge Dr., St. Louis, MO 63119.

CIRCLE INQUIRY NO. 158

Package for attorneys and consultants, the Professional Office Management system, allows practitioners to keep track of professional time, schedule appointments and work assignments, prepare bills, prepare third party bills and claims, and do cost accounting for fixed price or retainer type assignments. The system is suitable for small professional practices such as legal clinics, management consultants, or architectural and engineering firms. The system allows the setting up of client jobs, the scheduling of appointments and work schedules, the preparation of bills for professional service and the preparation of special reports suitable for third party billing or internal management reporting. The system requires a 48K Apple II or Apple II Plus with at least two disk drives and a 130 column printer. Charles Mann & Assoc., Micro Software Division, 7594 San Remo Trail, Yucca Valley, CA 92284, (714) 365-9718.

CIRCLE INQUIRY NO. 174

Video display board, Datacube model VR-109A, is a Multibus-compatible, memory-mapped device that can generate 12 or 24 lines of 40 to 80 characters each on an 18.6 KHz raster scan monitor under software control. Each character position provides 4 display attributes (regular or reverse video, underline, half intensity, and blink) useable in any combination, as well as limited graphics capability. Producing direct (X-Y)



and composite video outputs, the unit can display up to 128 different characters in each position using a 7 by 9 dot matrix font with 3 dot descenders. At DMA access rates, the display is non-flashing. An input port is provided for an external keyboard operating in an interrupt or polled mode. Price: \$560 (1-9 quantity) and \$395 (100-499 quantity). Datacube, Inc., 670 Main St., Reading, MA 01867, (617) 944-4600.

CIRCLE INQUIRY NO. 175

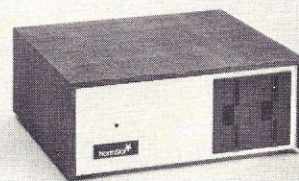
Transistor arrays for high-frequency applications in the 5 GHz range include the SL2363C, packaged in a 10-lead T05 encapsulation, and the SL2354C is a 14-lead dual in-line ceramic encapsulation. Each contains transistor arrays internally connected to form a dual long-tailed pair with tail transistors. Manufactured on a high-speed bipolar process, the arrays are designed for such applications as wide-band amplification, fiber optic systems, 140 and 560 megabit PCM systems, high performance instrumentation and radio/satellite communications. Plessey Semiconductors, 1641 Kaiser Ave., Irvine, CA 92714, (714) 540-9979.

CIRCLE INQUIRY NO. 176

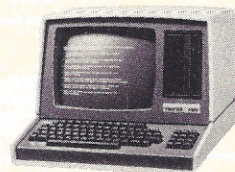
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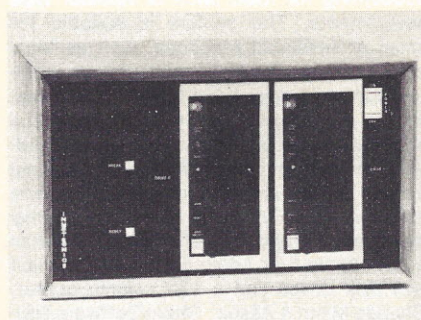
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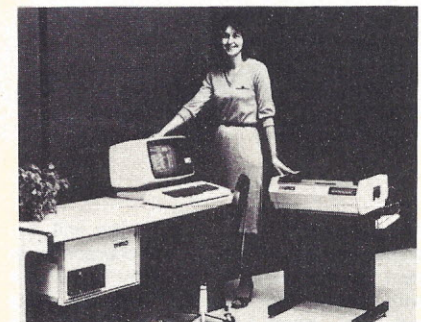
Expandable micro system incorporates a pair of unique floppy disk drives with full status indicator panels that display drive performance. The Innotronics model 6100 is a Z80A-based microcomputer system that features two 8-inch double density, floppy disk drives with six status indicators each to verify major functions, while aiding operation, programming, and debugging. Disk capacity is 1 million bytes, and main memory provides a 64K byte capacity. Each drive has a write



protect switch, and two additional disk drives can be added at any time. It is compatible with the CP/M operating system, IBM 3740 single-density format, IBM 2D double-density format, S100 bus (IEEE standard), and RS232C. Four slots in the backplane can accept modems, graphics, additional I/O and memory. Price: \$4,950. Innotronics Corp., Brooks Rd., Lincoln, MA 01773, (617) 259-0600.

CIRCLE INQUIRY NO. 159

Fuel oil management system for fuel oil and LP gas dealers controls budget, credit, product delivery, accounting, profit and loss statements, truck and driver utilization. Basic configuration is expandable from 1500 to 100,000 accounts. No computer experience



is needed. Priced from \$400/month depending on hardware/software configuration (60-month lease purchase). Infotecs, Inc., One Perimeter Rd., Manchester, NH 03103, (603) 624-2700.

CIRCLE INQUIRY NO. 160

Two 5.25-inch minifloppy disk drives, the SA410 (single-sided) and SA460 (double-sided), feature unformatted capacities of 500 kilobytes and one megabyte, respectively, using double-density recording. The two drives incorporate a helical cam v-groove lead screw for head positioning, rather than a band or disk positioner, for improved access time. The single-point ball follower in the screw eliminates hysteresis (backlash) and minimizes friction. The drives also use a fast-starting DC spindle motor instead of the head-loading solenoid used in other drives. The motor allows the drive to be shut down when not in use to avoid the problems of

head and media wear and damage caused by solenoid-controlled head loading. Other features of the drives include a track-to-track access time of 6 msec provided by a stepper motor that eliminates cyclic pole-to-pole error; a reduced component count due to LSI circuits; an integral tachometer that provides precision servo speed control; glass-bonded ceramic read/write heads; a "door open or disturbed" signal; and an activity or "in use" indicator. Advanced MFM recording provides density of 5876 bits per inch. Price in quantities of 100: SA410-\$325 and SA460-\$400. Shugart Associates, 475 Oakmead Parkway, Sunnyvale, CA 94086, (408) 733-0100.

CIRCLE INQUIRY NO. 161

Documentation organizer provides filing for work-in-process and reference material at the work station. Designed to mount on any 60-inch by 30-inch floor-supported desk or work station, a variety of filing components that can be configured to meet individual



requirements, including: work-in-process storage compartments, hanger bars, shelves, racks and cabinets with lift-up self-storing doors. Wright Line, Inc., 160 Gold Star Blvd., Worcester, MA 01606.

CIRCLE INQUIRY NO. 162

Hand-held light pen, Ruby Wand, for reading low-density bar code labels, including dot matrix printed labels, success-



fully reads labels with bars and spaces of 0.014-inch or wider. Scan velocity can be up to 30-inches per second. Features include a synthetic sapphire (ruby) ball pen tip that is virtually wearproof, glides easily over any surface, and is highly resistant to impact damage. The ruby tip acts as a lens to focus a photo detector to a spot on the label surface. A low power, long life LED light source above the ruby ball irradiates the label. Prices range from \$160 to \$286, depending on quantity. Interface Mechanisms, Inc., P.O. Box N, Lynnwood, WA 98036, (206) 743-7036.

CIRCLE INQUIRY NO. 163

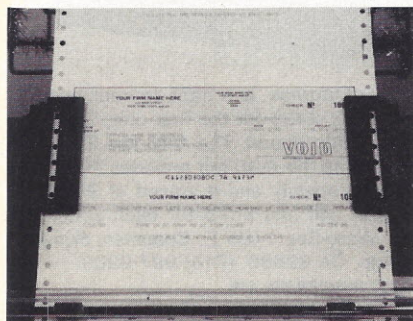
Stock continuous forms imprint continuous checks, statements, and invoices specifically designed to work with many major software packages. A wide range of sizes and formats are available. Off-the-shelf forms line features low minimum orders, 1½ or 3 week shipment, quantity discounts, and factory direct freight-paid service. Also, complete custom forms service is available to handle any specialized needs. Checks To-Go, 8384 Hercules St., La Mesa, CA 92041.

CIRCLE INQUIRY NO. 164

Dual-sided reversible 5¼-inch mini flexible disk compatible with TRS-80, Apple, Commodore provides twice the storage capacity of other disks by permitting users to record on both the front and the reverse side and is the first time a dual-sided reversible disk has been available in 5¼-inch mini format. The disks are rated for more than 12 million passes without disk related errors or significant wear. List price: \$5.95. Dennison Kybe Corp., 132 Calvary St., Waltham, MA 02154, (617) 899-0012, outside of MA, toll-free: (800) 225-8715.

CIRCLE INQUIRY NO. 165

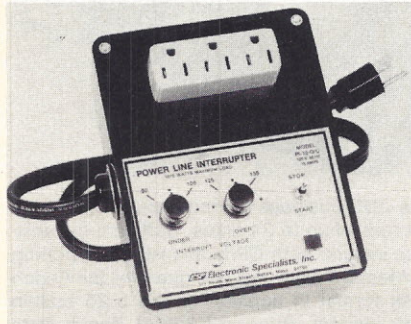
Checks for computer users are designed to be used for either payroll or accounts payable and are blank except for the customer's name and the consecutive check number, either of which can be deleted if



desired. Available in quantities as low as 500 @ \$29.95. Prices include printing customer's name and address, bank name and number, consecutive numbering and micr code line. Nebs Computer Forms, 78 Hollis St., Groton, MA 01450.

CIRCLE INQUIRY NO. 166

Power line interrupter, should AC line voltage be disrupted or exceed selectable limits, disconnects power from controlled apparatus. Front panel controls provide under/over voltage interrupt level selection and power reset. Other features include integral spike/surge suppression and response



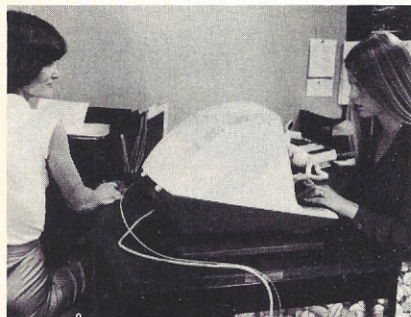
delay to prevent false interrupts. Model PI-15-O/U over and under voltage is \$142.95, model PI-15-U under voltage only is \$127.95.

FEBRUARY 1981

Electronic Specialists, Inc., 171 S. Main St., Natick, MA 01760, (617) 655-1532.

CIRCLE INQUIRY NO. 167

Lazy susan swivel device, Turn 'n Key, allows full 180° rotation of a CRT terminal,



enabling two or more operators to use the same unit without upsetting their work en-

vironment, and lets each operator place the CRT at a variety of angles, reducing unnecessary keying efforts. The walnut laminated surface wipes clean with a cloth and features smooth-rolling ball-bearing assembly and neoprene cushion to minimize computer-room noise. The 16 in. size is \$55, 20 in. size is \$62. Inmac, Dept. 1022, 2465 Augustine Dr., Santa Clara, CA 95051.

CIRCLE INQUIRY NO. 168

Mini-portable 1022A Travelscope, is small enough to fit in an attache case (8 by 7 by 3 in. and weighing 5 lbs.) offers standard-size instrument feel for operation and function, has had its range speed to 15 MHz, and has battery-pack compatibility. Mounting holes are on the rear panel to accommodate the pack, enabling field retrofit to be made in less than 10 minutes. The Option 05 battery pack, costing \$185 with 45 to 60 days ARO

REPORT WRITER™ ... a success story

by Richard Bley, President/Operations

Around the offices of Carolina Business Computers everyday seems like Christmas. Since the introduction of Report Writer, orders have been pouring in at a remarkable rate. Thanks for your patronage.

Usefulness

I have come to the conclusion that RW sells because it's a useful piece of software. I gave my programmers the task of creating a VisiCalc-like report generator written in Microsoft BASIC to run under CP/M.** The specifications called for a program that would allow data entry into a definable reporting format with report printing on request. We felt fundamental to all report generators were the need for arithmetic capability, element replication, and data position referencing. Of course, the program had to be easy to use, easy to understand, and be able to facilitate "what-if" analysis. The finished product

met the criteria. Enhancements have been made periodically. In fact, the latest addition truly makes RW the most useful report generator on the market. You now have the ability to produce a hard-copy listing of the report specifications (element referencing, arithmetic calculations, etc.)

Justification

RW does for CP/M systems what VisiCalc does for the desktop computers—it gives the end-user another reason to justify purchase of a system.

Versatility

Like any good software product, RW has versatility built-in. In fact, I'm surprised by the types of reports that people are generating with RW. Versatility (in this sense, not being constrained to a strict set of criteria) facilitates creativeness. And the user is left to design because of the tool, not in spite of it.

What We Offer

Of course, the program. If you have a CP/M system, with Microsoft BASIC, and \$150 you may use a bit of our creative talents. Call us or see your local RW dealer. In addition, we now coordinate a new service for our RW users. RWUG (Report Writer Users Group) will be a clearinghouse for user submitted comments, ideas for enhancements, sample reports, etc. Through a periodic newsletter, we will present a compendium of these items. To make sure you're on the RWUG mailing list, be certain to return your License Agreement. For those of you that already use RW, drop us a card listing your name, address, phone number, and from whom you purchased our product. If you will take the time to submit your ideas concerning RW, maybe including some sample reports, we will all benefit. Mail them to The RWUG, our address.



CAROLINA BUSINESS COMPUTERS
Oakwood Center, 350 3rd Ave., NW
Hickory, North Carolina 28601
Telephone (704) 322-6005

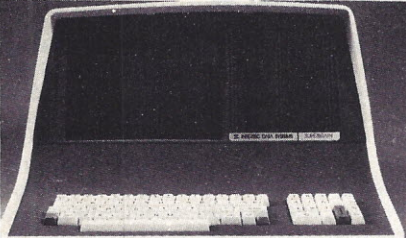
*VisiCalc is a registered trademark of Personal Software, Inc.
**CP/M is a registered trademark of Digital Research.

CIRCLE INQUIRY NO. 73

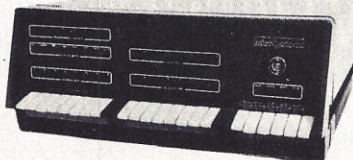
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Computers Wholesale

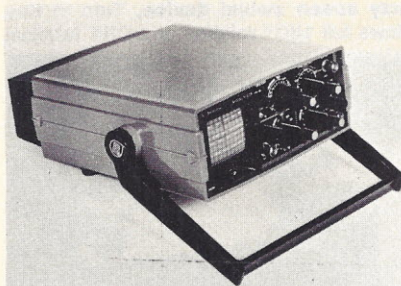
P.O. Box 144 Camillus, NY 13031



(315) 472-2582



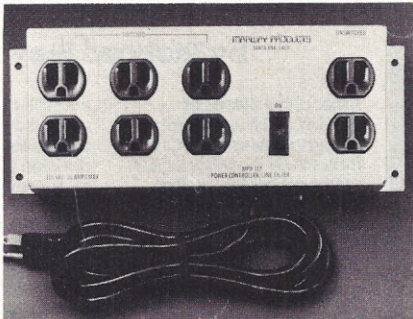
delivery, includes sealed rechargeable NiCad batteries, a charging circuit and electronic switching components. Recharge



time is 14 hours and recharging (trickle charge) takes place when operated from the wall-mounted AC/DC converter. Ballantine Laboratories, Inc., P.O. Box 97, Boonton, NJ 07005.

CIRCLE INQUIRY NO. 169

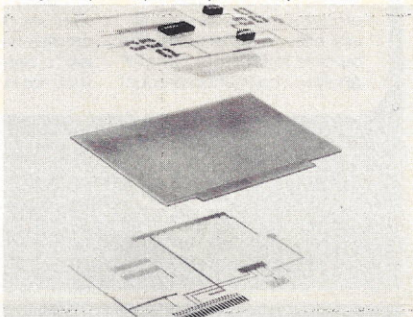
Power controller, MDP 117, for office computer, home electronics and test system use is a high-performance device that has eight outlets (two direct and six switched), EMI filter for eliminating surges, glitches and line transients, and heavy-duty UL-approved components. The sturdy metal controller plugs into any ordinary wall socket, transforming sporadic electricity flow into steady, smooth and noise-free power to up to eight



electronic devices. The unit is especially useful with small business and home computer systems, audio visual recording systems and situations where many devices that can be affected by static, noise interference and sudden changes in power flow are used. Price: \$89. Marway Products Inc., 2421 S. Birch St., Santa Ana, CA 92707, (714) 549-0623.

CIRCLE INQUIRY NO. 170

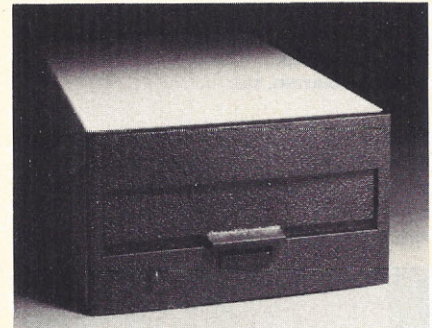
Design system, E-Z Bus, permits maximum creativity in microprocessor interface design using the plain, reshaped and predrilled bus



cards in combination with copper printed circuit design products and standard hardware and accessories. Bus card selection includes plugboards precision preshaped for complete compatibility with the Apple II, PET, Super Kim, TI980, Altair 8800, Insai 8080, DEC, PDP, Heath, S-100, Motorola, Intel SBC80, and National BLC80 microprocessor units. Customized microprocessor plugboards are available on request. Bishop Graphics, Inc., 5338 Sterling Center Dr., P.O. Box 5007, Westlake Village, CA 91359, (213) 991-2600.

CIRCLE INQUIRY NO. 171

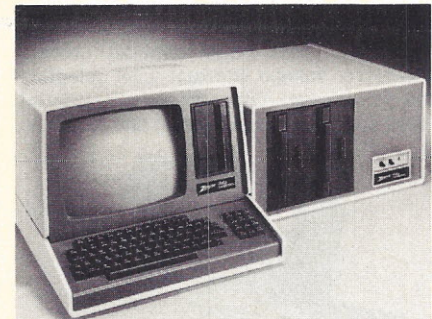
Two diskettes, A-70 and A-40, are available for Apple computers. These diskettes have a jumper selectable boot Prom for 13 to 16 sector integer Basic or Pascal as standard features. Both diskettes have band positioning instead of the commonly used plastic cam, plus an advanced media positioning system. The A-40 diskette provides 40



tracks of storage, and track to track speeds of 5ms for \$495 for the first unit, \$395 for each additional unit. The A-70 has the same features as the A-40 but provides 70 tracks storage capacity and is priced at \$675 for the first unit and \$575 for each additional unit. Micro-Sci, 1405 E. Chapman, Suite E, Orange, CA 92666, (714) 997-9260.

CIRCLE INQUIRY NO. 172

Two megabyte floppy disk drive, designed for use with the Z-89 microcomputer, permits greater flexibility in most business applications. The Z-47 can provide up to 2½ million bytes of data and program storage, when used with the ZDS microcomputer built-in 5.25-inch disk drive. Each disk provides space for one million bytes of data. When added to the built-in capacity of the Z-89's 5.25-inch disk system, the data capacity of



the ZDS business microcomputer system is increased up to 24 times. Software capabilities include both CP/M and HDOS operating systems. These are designed for the 8-inch disk format in addition to the 5.25 built-in disk system. Price is \$3,695. Zenith Data Systems, 1000 Milwaukee Ave., Glenview, IL 60025, (312) 391-8181.

CIRCLE INQUIRY NO. 173

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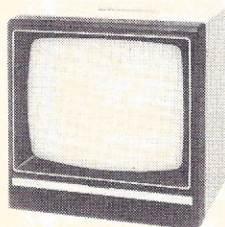
California Computer Systems:

• 2065A 64K Dyn. RAM Bd.	550
• 2116C 16K Stat. RAM Bd.	345
• 2200A 12 Slt. S-100 Mnfrm.	379
• 2422A Floppy Disk Controller	350
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CALENDAR

Feb 3 Invitational Computer Conference, Pier 66 Hotel, 17th St. Causeway, Ft. Lauderdale, FL 33310, one in a series of national conferences including displays of operating equipment by several leading manufacturers. Also Feb 5 in Atlanta, GA, Mar 3 in Dallas, TX, Mar 5 in Houston, TX, and Apr 2 in Denver, CO. B.J. Johnson and Assoc., 2503 Eastbluff Dr., Suite 203, Newport Beach, CA 92660.

Feb 4-5 Computer and Office Automation Show and Conference, Hyatt Regency Hotel, Vancouver, British Columbia, data processing equipment, small business computers, peripheral products, medium and high speed copiers, word processing systems, data communications gear and services. Whitshed Publishing Ltd., Manulife Centre, 55 Bloor St. W., Suite 1201, Toronto, Ontario, Canada M4W 3K2, (416) 967-6200.

Feb 9-13 Data Communications Institute courses, Jack Tar Hotel, San Francisco, CA, comprehensive short course for non-engineering professionals, with emphasis on gaining knowledge and understanding rather than operating skills. Also held Mar 30-Apr 3 at Boston Marriott Hotel, Newton, MA. Data Communications Institute, McGraw Hill Conference and Exposition Center, 1221 Ave. of the Americas, Suite 3677, New York, NY 10020, (212) 997-4930.

Feb 9-13 Reliability Engineering short courses, UCLA, Los Angeles, CA, series of courses designed for reliability, product assurance, logistics, quality assurance and design engineers, as well as specialists, vice presidents, directors, supervisors and group leaders. Continuing Education in Engineering and Mathematics, UCLA Extension, Box 24901, Los Angeles, CA 90024, (213) 825-1047.

Feb 24-26 Nepcon West '81, Convention Center, Anaheim, CA, PCB/PWB microelectric materials, hardware, tools, supplies, and test instruments for engineering packaging/production specialties. ISCM, 222 W. Adams St., Chicago, IL 60606, (312) 263-4866.

Mar 24-26 SSE '81, Southwest Semiconductor Exposition, Civic Plaza Convention Center, Phoenix, AZ, exhibitions and semiconductor, hybrid, and printed circuit board production, processing, and test equipment. Cartledge & Assoc., 491 Macara Ave., Suite 1014, Sunnyvale, CA 94086, (408) 245-6870.

Mar 31-Apr 2 Cincinnati Business Show, Convention-Exposition Center, Cincinnati, OH, exhibitions of automated systems, communications, computers, telephone systems, word processing, data processing, supplies, printing equipment, furniture, bindings, graphics, forms. Weber & Assoc., 5679 Creek Rd., Cincinnati, OH, 45242, (513) 531-5959.

Apr 1-2 Southwest Printed Circuits & Microelectronics Exposition, Market Hall, Dallas, TX, manufacturing exhibits and displays geared to regions of Texas, Oklahoma, Arkansas, Louisiana, and New Mexico. Also held Apr 15-16 at Sheraton Twin-Tower Convention Center, Orlando, FL for south-eastern regions. Industrial & Scientific Conference Mgmt., Inc., 222 W. Adams St., Chicago, IL 60606, (312) 263-4866.

Apr 1-8 Hanover Fair '81, Hanover, Germany, exhibitions of microcomputers, word processors, data processing and office equipment. Interface Age will exhibit in Oebit-Nord (Hall 1), Stand A-503. Hanover Fair Information Center, P.O. Box 338, Whitehouse, NJ 08888, (201) 534-9044, Telex 833493.

Apr 7-9 Electro/81 Film Theater, New York, NY, showing recent and notable engineering and general science films for an audience of technical executives. Dale Litherland, Suite 410, 999 N. Sepulveda Blvd., El Segundo, CA 90245.

Apr 28-30 International Telecommunications Forum, Concorde Lafayette Hotel, Paris, France, discussing strategies for suppliers and users in new telecommunication products and services. Dusty Rhodes, Arthur D. Little Decision Resources, Acorn Park, Cambridge, MA 02140, (617) 267-3456.

Apr 29-May 1 Manchester Micro Show, New Century Hall, Middlesex, England, exhibition of micro systems, business micros, personal computers, word processors. Online Conferences Ltd., Argyle House, Joel St., Northwood Hills, HA6 ITS, Middlesex, England, (09274) 28211, Telex 923498.

May 5-8 PICA '81, Marriott Motor Inn, Philadelphia, PA, conference on power industry computer applications. T.A. Suman, Philadelphia Electric Co., 2301 Market St. N3-1, Philadelphia, PA 19101, (215) 841-6397.

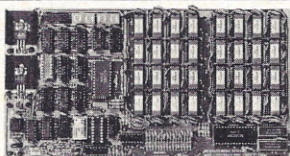
May 10-13 European Consumer Electronics Show, Nuremburg Fair Centre, Nuremburg, W. Germany, exhibitors from all over the world, including U.S., Japan, Europe, and the Far East, offering a complete range of electronic equipment

for business and consumer use. Tom May, Industrial and Trade Fairs, Ltd., Radcliffe House, Bleaheim Ct., Solihull, West Midlands B91 2BG, England, (021) 705-6707, Telex: 337073.

May 13-16 International Business Show, Tokyo International Trade Fair Grounds, Harumi, Tokyo, Japan, displays of business machines and equipment including desktop calculators, electronic cash registers, data processing machines, peripherals, filing systems, facsimiles and other communication systems and equipment. Nippon Administrative Mgmt., Seikyo Kaikan Bldg., 1-13, Sendagay 4-chome, Shibuya-ku, Tokyo, Japan, (03) 403-1331.

May 26-29 Korea International Office Management Exposition, Exhibition Center, Seoul, Korea, computers, facsimile systems, copiers and duplicators. Clapp and Poliak, Int'l., 7315 Wisconsin Ave., Washington, D.C. 20014, (301) 657-3090.

June 15-18 National Computer Graphics Conference, Convention Center, Baltimore, MD, tutorials, meetings, and exhibits on business graphics, computer mapping, financial, educational, and medical graphics, design, software and database, telecommunications, and marketing graphics. NCGA, 2033 M Street, N.W., Suite 330, Washington, D.C. 20036, (202) 466-5895.



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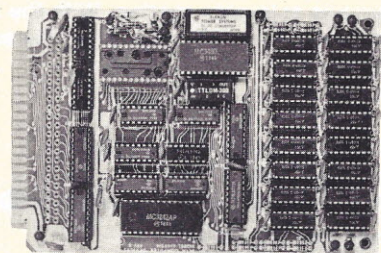
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BOOK REVIEWS

Pascal

by **Paul M. Chirlian**

Matrix Publishers, Portland, OR

Reviewed by David Marca

The first impression upon picking up this book is that it's just another classical textbook on a programming language. Upon further examination, it becomes apparent that there is more substance than usual.

Two big pluses are good use of examples and language summaries. The examples serve to bombard the reader with Pascal code and imbed a language feature within a working cluster of a program code. They have been typed from actual program listings that clearly explain proper usage of language features. Summaries of Pascal appear in tabular and graphic forms. The tables provide an easily accessible collection of commonly needed language information. Syntax diagrams provide a concise summary of each language part. It is easy to see all possible formations of such procedure declarations as 'if-then-else'.

The actual language coverage is quite good. The more standard features (identifiers, procedures, constructs) are covered, as well as other important topics (I/O, sets, records, and dynamic data structures.) All in all, it's an interesting book that can help unclutter the morass of information found in user manuals.

212 pages \$9.95

Computers and Social Controversy

by **Tom Logsdon**

Computer Science Press, Potomac, MD

Reviewed by Jim Schreier

This book attempts a major feat: exploring the world of computers in society. The author favors an anti-business point-of-view spiced with a keen sense of humor. Jerry Schneider's successful scheme to defraud Pacific Telephone out of eight million dollars of equipment is followed, 18 pages later, by a quote of Robert Morris of Bell Telephone that the data encryption standard "...is too insecure to be used in the Bell System."

Logsdon hits almost every controversial issue including the rights of privacy and computer uses in atomic warfare. The issues are very well documented, mostly from contemporary magazine articles. Sometimes the documentation is followed by hearsay. For example the author insists that some businesses "...even set up dummy accounts in Phoenix, AZ, because the banks in that region provide notoriously slow service."

The book is enjoyable reading. With the help of an aware instructor, it could be the basis of an interesting high school level course.

397 pages \$15.95

Structured Basic and Beyond

by **Wayne Ansbury**

Computer Science Press, Potomac, MD

Reviewed by Rocky Smolin

This textbook is a good opportunity for students to become exposed to computers. The structured approach to learning is a natural outgrowth of the broadening computer user base. People who are not naturally oriented towards technology must still learn the skills.

The author plunges directly into the fundamental actions of the computer (input, output, run, branch, conditional branches, etc.), then introduces the first structures—loop (infinite,

while, until, if, for-next, etc.) and case structure. These are explained with pseudo-language that accustoms the beginner to reading procedure type programs without having to learn a specific language.

The book covers almost every topic in programming—dimensions and arrays, string manipulation, boolean logic, files, linked lists, stacks, queues, and tree-like structures—in a comprehensible, non-technical fashion.

For those in the humanities, required to take a computer programming course, the book has much to offer. For self-taught programmer/hobbyists, it stretches programming capabilities by introducing many topics not normally covered, reinforcing lessons with excellent program problems. It is entertaining as well as educational.

310 pages \$10.95

Computer Selection Handbook

Decision Resources Corp., Rancho Palos Verdes, CA

Buying and installing a computer system for the small business is a task of almost impossible complexity. This situation has given rise to a spate of 'how to' publications to aid the beginner. Most are fair to poor in quality, but this handbook is an exception. It emphasizes areas overlooked by most evaluations: the business, what its goals are, how it will be affected by automation, and how to prepare for implementation.

The first section is concerned with setting goals. The objective is to evaluate your current business operations to see if any are candidates for automation.

Next, there is an evaluation of options—computer manufacturers, timesharing companies, service bureaus—guiding the reader through the intricacies of soliciting proposals from vendors. The reader is advised on selection of the best vendor to satisfy current and future automation requirements.

The following section lists the tools to plan, coordinate and control automation installation.

The final chapter concerns itself with managing the system. It will teach the reader how to establish the necessary methods, procedures, and responsibilities to continue a successful operation. It also gives advice on how to maintain vendor involvement and support, and measures the success of the initial goals.

Several useful appendices include: a list of vendors (mostly minis), a glossary of computer terms, a bibliography, and an introduction to hardware and software.

First time buyers need to understand that hardware and software are merely tools; familiarity with the factors that precede and follow a system installation is much more important. This handbook takes a giant step in that direction; it is highly recommended.

R.S.

138 pages \$37.25

TRS-80 Interfacing Book 2

by **Jonathan Titus, Christopher Titus, and David Larsen**

Howard Sams, Indianapolis, IN

Book 2 in this series picks up where book 1 left off, discussing some very sophisticated interfacing topics. It is not for the electronics novice; the authors have omitted step-by-step experiments and breadboarding, assuming that the reader has mastered the elementary techniques. The style is clear and informative; the ability to present fairly complex topics without jargon or academic verbiage should serve as an example to all technical writers.

The first section covers the controlling or driving of both low-voltage and low-current peripheral devices, such as light

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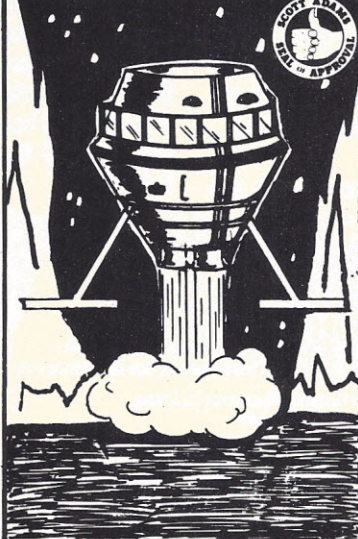
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BOOK REVIEWS

emitting diodes and high-voltage and high-current devices such as motors and lamps.

Next is a presentation of analog-to-digital and digital-to-analog conversion. Though no specific experiments are presented, just toying with the circuitry will lead to many exciting applications.

Another section includes a necessary discussion of practical data processing—sampling rates, averaging, digital filtering, least squares and correlation coefficient methodology. Some mathematical knowledge is required.

In perhaps the most interesting section, the authors plunge into the world of telecommunications and remote control with an extensive and detailed presentation of asynchronous-serial data transmission and the universal synchronous receiver/transmitter chips. They include software that can be used in computer-to-computer communications.

Finally, there is an enlightening discussion of the TRS-80 interrupt structure and how it can be used to help control peripheral devices.

For those seriously interested in learning how to interface computers to the real world, the book is a gem. **R.S.**

254 pages \$9.95

How to Computerize your Small Business

by Jules A. Cohen

Prentice-Hall, Englewood Cliffs, NJ

Computerizing the small business seems to be an almost impossible task, involving large capital outlay and business risks. Many books are written to mitigate the hazards of automation and enhance the possibility of successful conversion. This book, unfortunately, does not succeed at this task.

Although some useful information is contained, it is obscured by a dry and wordy style. An introduction would be helpful, stating who the book is addressing, what level of expertise is expected, and what size company the author is defining as small.

The case study is a firm in the \$5-\$10 million per year sales range. The systems used range in initial investment from \$170,000-\$216,000. Cohen seems to have missed his market. These are neither small businesses, nor small investments. Companies that can afford investments of this size would have sales triple the amounts of the case study company. They would include a data processing department and professional staff. There would be sufficient expertise to interface with hardware and software vendors; the chief executive would not concern himself with these details.

A how-to book should be directed to businesses in the \$500,000-\$5,000,000 per year sales range, who will be looking for micro-based systems in the \$10,000-\$50,000 price range. They will have no expertise in the field, no internal staff to draw on, and will become intimately involved in the selection process. This is the market that needs to be addressed. **R.S.**

169 pages \$7.95

Pathways through the ROM

by George Blank, Roger Fuller, John Hartford,

John T. Phillipp, and Robert M. Richardson

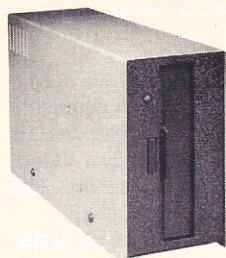
Softside Publications, Milford, NH

Reviewed by David Civan

This book is essentially an assembly language programming handbook for TRS-80 users. Assembly language programming significantly reduces the amount of memory a program occupies and the amount of time it takes to run.

The book does not actually explain how to program in assembly language; its purpose is to discuss how level II

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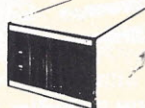
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BOOK REVIEWS

Basic ROM subroutines can be integrated into assembly language programs to economize on memory. The text is loosely organized; the four sections are minimally related, their only link being the use of hexadecimal notation. The articles included are excerpts from other publications.

Some material that is interesting includes: programs to disassemble level II Basic, the Z-80 chip, and the TRS-80 disk operating system plus specifications for the floppy disk controller chip used by Radio Shack.

Other sections are poorly written. Although beginners should be warned that the book is only for the experienced, few experts will appreciate the excessive jargon and abbreviations.

Many pages of program listings are provided. The listings are legible, but lack such conveniences as spaces between words, making it more difficult to read.

The book is intriguing, but flawed by its lack of clarity. Owners of TRS-80 level II computers should find it somewhat useful.

116 pages \$19.95

Microprocessor Software Book 2

edited by Martin Whitbread

Castle House Publishing, Kent, England

Reviewed by Roger H. Edelson

This book consists of 32 reprints of recent articles on software subjects from leading periodicals in the microcomputer field. It is divided into sections covering techniques and methods, selection of languages, advances in techniques, and software applications. Two other chapters covering testing and future standards include one reprint each.

The first section is excellent, with superb reprints of articles on structured programming and techniques. The dictum of structure in programming and system design and testing is an underlying theme and provides unity for articles from such varied journals. The discussion of the Pascal language is another highlight; however, the reprint suffers due to poor reproduction of the colored boxes used to highlight the statements.

The only other flaw is the lack of an index; this makes it difficult to use as a reference volume.

The book has something of interest to everyone in the microprocessing field.

150 pages \$27.50 in U.S.

An Introduction to Microcomputers, Vol. 1, Basic Concepts

by Adam Osborne

Osborne/McGraw Hill, Berkeley, CA

Reviewed by Dennis Doonan

This is the second in a series of four volumes that have become widespread educational standards. This new edition is revised, expanded, and updated. Using bold face type for key ideas and light face type for background information, it provides an easy-to-use reference. Readers need only a minimum background. The precise style provides a strong background in microcomputer concepts.

The book begins with a brief history of computers and leads to the introduction of the microprocessor. The binary digit is introduced as the basis of all computers; its use in various number systems, binary arithmetic, and computer logic is presented.

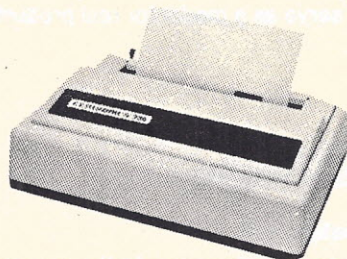
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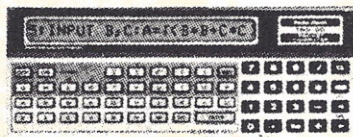
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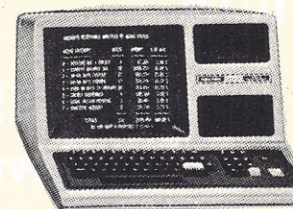
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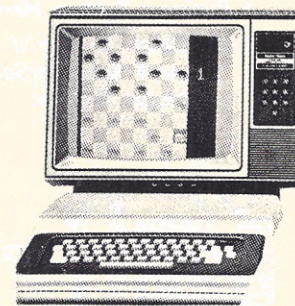
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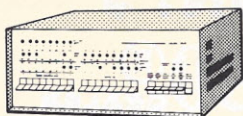
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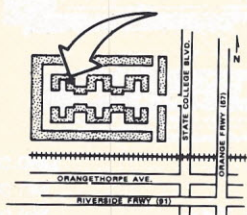
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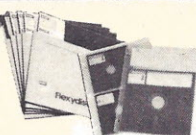
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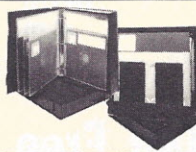
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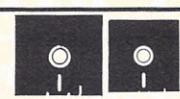
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BOOK REVIEWS

discussion includes multi-byte words and data, number codes, floating point, signed numbers, as well as text and character codes. A simple binary addition program is used to illustrate the operation of microprocessor instructions.

The heart of the microcomputer, the central processing unit, is explained. Following a simple program, the book shows how registers are used, how their contents change, and how instructions are handled. Using illustrations and timing charts, the internal operation of the CPU is followed through a complete fetch and execute operation of an instruction.

A temperature controller shows the additional logic needed to make the CPU a usable microcomputer. System bus, external memory, and input/output are presented to show the basics of interfacing.

A chapter on programming demonstrates the way an instruction can specify a logic sequence in the CPU, giving design considerations needed to select the proper microprocessor. Programming languages are introduced and assembly language programming is detailed.

The last chapter creates a hypothetical microprocessor complete with a full instruction set and architecture. Each element is explained and justified. The system requirements and operation of this unit serve as a model for real products.

480 pages \$12.50

Conversational Basic, A Dialogue Approach to Programming by Michael E. Mulcahy CBI Publishing Co., Boston, MA

Each book on Basic seeks a fresh approach; this one is no exception. The author presents information in the form of an ongoing dialogue between a teacher and his students. The book is easy for the beginner, yet is applicable to the mature reader. Classroom experience is provided by questions and answers, student humor, homework assignments and bugs to find in sample programs. The information is general and can be customized to the reader's interest. While a time-share version of Basic is used, most of the material is suitable for the home user.

The book is divided into three sections, each complete with a review and quiz. The first section introduces programming by presenting a few common commands, counting, simple loops arithmetic operations, variables and 'data' statements.

The second section develops programming skills. Machine language programming is briefly introduced using Demol—a hypothetical decimal based computer complete with memory and an instruction set. The lessons are not always heavy going; to show the use of the 'print tab' command, the student is urged to write a program that prints a pattern or design. Formalized and nested loops and functions are clearly explained and illustrated. Students learn to debug programs by finding the syntactical errors in sample programs.

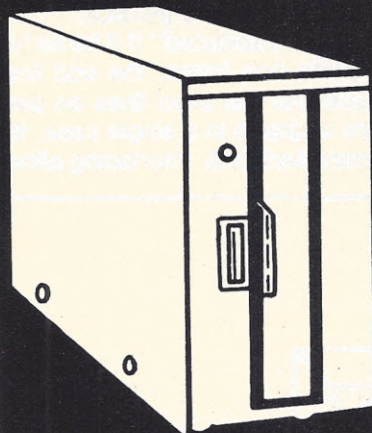
The final section presents subroutines and time saving commands such as print formatting. Sorting is introduced with only the inefficient bubble sort, but the explanation is easy to follow. The chapters on matrice manipulation are a bit skimpy and may be confusing to readers without computers. Data files are briefly described for use on the time-share systems. Since Basic has idiosyncracies, a chapter on these is included to save the beginner a few headaches. The book ends where most others begin—with a superficial history of computers.

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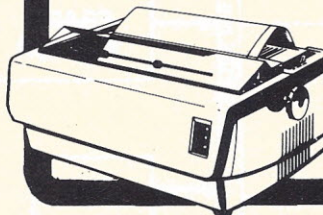


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Computer Graphics continued from page 68

contrast of the stored image renders observation in a brightly lit room difficult.

Until recently, interactive applications were also a problem for the DVST. Both the semipermanent nature of the stored image and the presence of an annoying flash during screen erasure made this a less than optimal candidate for real time rotations and translations. A recently-introduced feature called "write-through" allows a limited amount of refreshed image creation. With write-through, a low energy writing gun can trace out a refreshable image at high speeds thus allowing interactive programming. Because of the lower energy level of this beam, the image will not have the contrast of the truly stored image.

The raster scan CRT is the most familiar display type because of its widespread use in home TV receivers. Because of its high production volume, a raster graphics system can be obtained for relatively little money. The basic structures in a raster scan CRT are (1) phosphor-coated screen, (2) an electron gun cathode, (3) beam

focusing system, (4) control modulator grid and (5) deflection system (figure 3). The phosphor used here differs from the storage tube type in that the persistence is on the order of milliseconds rather than hours. Persistence is the time interval during which the luminance decays to 1% of its peak value after the beam has been removed.

Typical phosphor persistence for rasters ranges between 10-100msec. In order to maintain an image on the screen, the deflection system causes the focused electron beam to continually scan the screen, refreshing the information of each picture element (pixel) along the way. The deflection pattern starts in the upper-left corner of the screen and traces out a pattern similar to that in figure 3. Each horizontal scan takes $54\mu\text{sec}$, with a $10\mu\text{sec}$ retrace. Each vertical scan takes $1/60\text{th}$ of a second in the American standard (NTSC).

The scan is referred to as "interlaced" if it takes two vertical passes to complete one frame, the odd lines being drawn on pass one and the even lines on pass two. If the entire picture is drawn in a single pass, the scan is referred to as noninterlaced. Interlacing allows

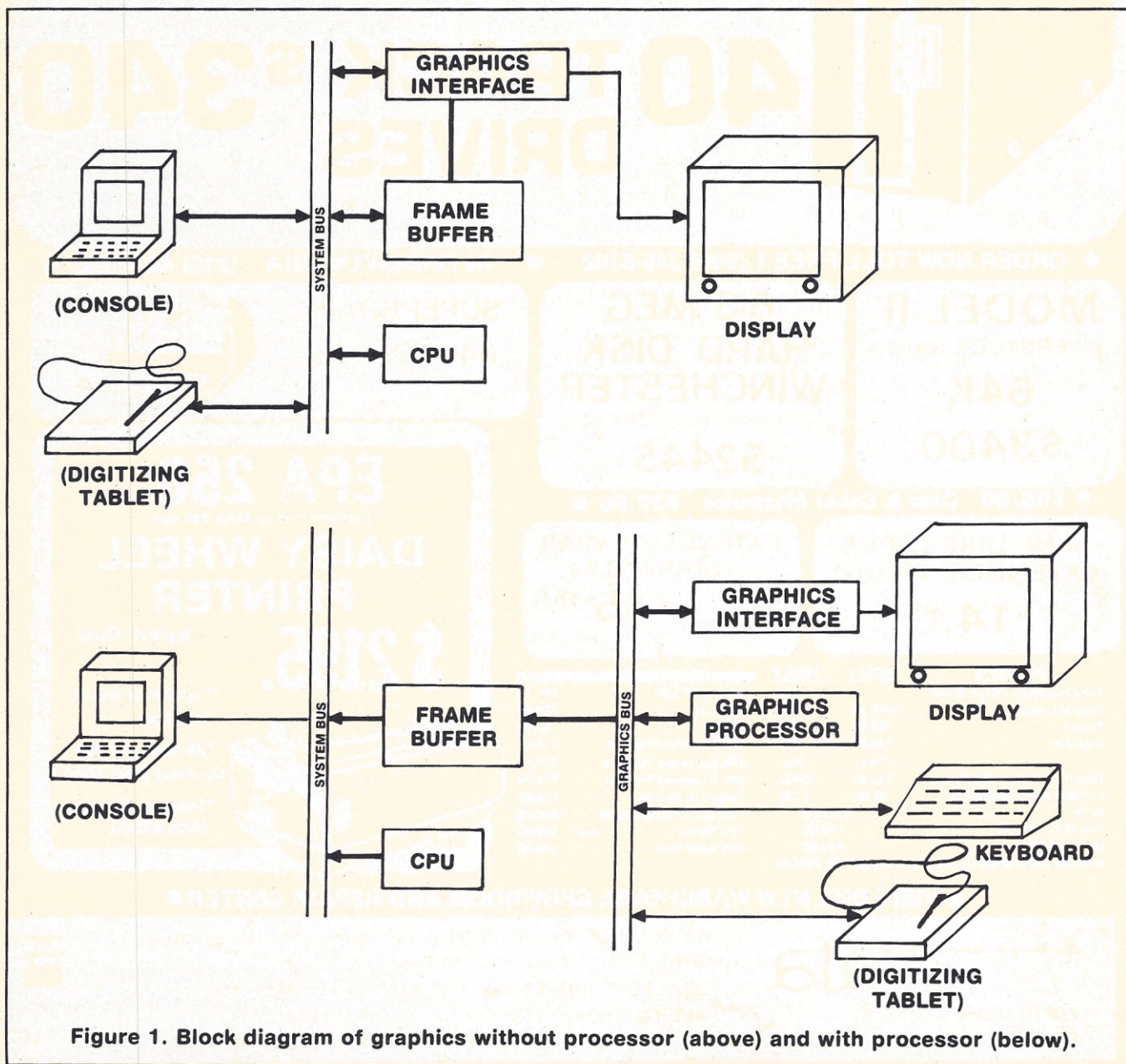


Figure 1. Block diagram of graphics without processor (above) and with processor (below).

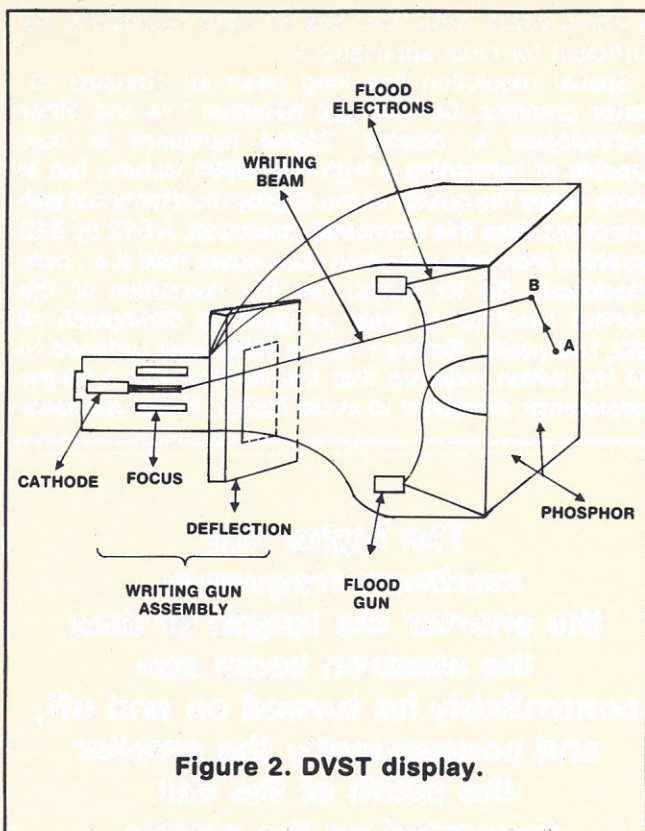


Figure 2. DVST display.

the refresh rate to be half of what would ordinarily be necessary to prevent screen flicker. This is one reason why interlaced scanning is used in NTSC broadcast work, which is standard for the TV industry. In an NTSC

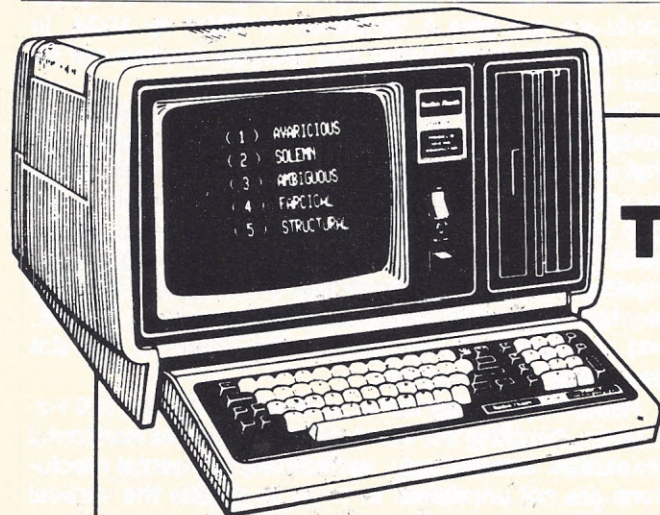
signal, each frame consists of 525 lines of which about 484 are visible.

Logically the screen is divided into thousands of small rectangular regions (pixels). The definition of a digital image depends solely on the color/intensity of each pixel. A frame buffer, usually RAM, holds a digital version of the image. The frame buffer is scanned by the graphics interface and converted into video information. The size of the frame buffer depends on the resolution requirements of the system. As RAM costs continue to decline, higher resolution devices will be available at a lower cost.

Spatial resolution of a raster system is given as the product of the number of horizontal pixels and the number of vertical pixels. Color resolution is determined by the number of color/intensity choices possible at each pixel. Color resolution is usually given as the number of bits per pixel. Thus a graphics system having 256 by 256 by 4-bit resolution can present 256 squared resolvable pixels each of which may display $2^4 = 16$ color/intensities.

In the most straightforward of buffer schemes, called bit mapping, each pixel corresponds to a group of bits in memory. The simplest bit map display assigns a single bit to each pixel. This would limit the color/intensity selection to two—black and white, for example.

The 256 by 256 by 4-bit example requires a frame buffer consisting of 64K nybbles (128K bytes) if stored in bit-mapped format. A convenient method of increasing the color resolution of a system is to break the frame buffer into modular sections called image planes. If a single image plane consists of a 256 by 256 by 4-bit module, by plugging in three such memory



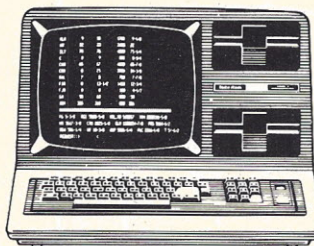
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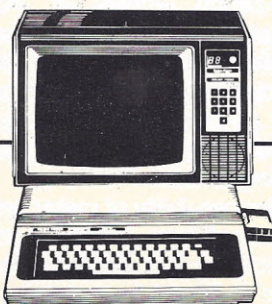
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planes the frame buffer has the equivalent of a 256 by 256 by 12-bit image memory, increasing the color resolution to 4096.

The multiple plane configuration is one solution to the speed limitation problem of refresh circuitry. Each plane's data is processed in parallel rather than increasing the DMA rate of the frame buffer. Two alternate solutions are scan conversion and alphagraphic mapping. With scan conversion, a rectilinear image is stored as a display list of vectors. Special hardware converts this relatively small list into voltages that modulate the control grid of the CRT.

In real time, the circuitry determines which, if any, vectors intersect a given horizontal scan line and at what points these intersections occur. If there are one or more intersections, the appropriate pixels on the line are lit. But this technique is not conducive to curvilinear images or solid figures.

Alphagraphic mapping is a technique used predominantly in graphics terminals, the popular IBM 3279 color terminal being a prime example. Here the well known dot-matrix method (usually used for alphanumeric representation) is made more general. When these graphics characters are printed in adjacent clusters, a graphical image results. The main drawback of alphagraphic displays is that, in order to complete generality, 80 graphics characters need to be present, and this is unrealistic. A smaller but useful subset must be settled for.

Putting aside color considerations for a moment, we can evaluate the raster scan method on other merits. Since every pixel is visited by the electron beam 30 or so times each second, interactive graphics and animation are readily implemented. Also, it takes no more effort to scan a complex picture with filled areas and curves than it does a simple stick figure.

Variable beam intensity means that, hypothetically, a continuum of shades is available. In reality, however, the precise number depends on the intensity resolution, which is dependent on digital hardware. It turns out that 30 or 40 gray levels are all that is needed for the eye to perceive an image as nondigital, so raster

systems which offer five bits of color resolution are sufficient for most applications.

Spatial resolution has long been an obstacle for raster graphics, but the gap between this and other technologies is closing. Digital hardware is now capable of refreshing a high resolution picture, but in some cases the quality of the display monitor is not sufficient to utilize this increased resolution. A 512 by 512 graphics interface will often use repeat field (i.e., non-interlaced), 60 Hz mode, but the resolution of the monitor must be at least as good to distinguish all 262,144 pixels. Refresh rate is effectively reduced to 30 Hz, which requires that the monitor use a longer persistence phosphor to avoid flicker. When success-

**The higher the
maximum frequency,
the shorter the length of time
the electron beam can
controllably be turned on and off,
and consequently the smaller
the width of the dot
generated on the screen.**

fully implemented, the proper combination of raster hardware can give a resolution of 1024 by 1024. In contrast, the best stroke and storage devices will be four to eight times better.

There are two ways in which spatial resolution is limited. In most systems, it is the number of scan lines that determines vertical resolution. Usually a specification called bandwidth determines the horizontal resolution. Bandwidth is the range of frequencies that can be used to modulate the control grid. The higher the maximum frequency, the shorter the length of time the electron beam can controllably be turned on and off, and consequently the smaller the width of the dot generated on the screen.

Home TV typically has a bandwidth of 5 MHz (60 Hz-5 MHz). Doubling the bandwidth doubles the horizontal resolution. Interestingly, vertical and horizontal resolutions are not unrelated. In order to double the vertical resolution, the bandwidth must be increased by a factor of 4.

Considerations other than resolution may, in certain applications, get priority. If TV broadcast compatibility is required, then conformance with a set of timing and synchronization signals is important. I mentioned earlier that line count and refresh rate were two constraints placed on NTSC signals. This alone limits an NTSC video signal to a vertical resolution of 484. Hence, if a resolution of 512 by 512 is quoted, it can be immediately determined that the system is not NTSC compatible.

The color capability of raster graphics is unapproached by its competitors. Virtually any imaginable color is reproducible by this system. To simplify the situation, colors are obtained by scanning the screen with three

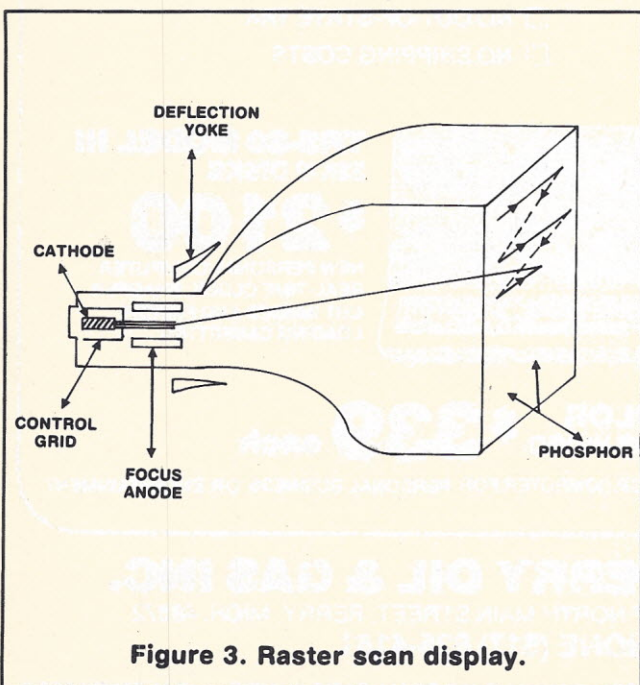


Figure 3. Raster scan display.

guns rather than one, each representing a color: red, green or blue.

When these are focused on a given pixel, their respective intensities determine the color of that pixel. The nature of the analog output signal presented to the monitor is a major factor in determining color quality. A color TV signal begins as four separate signals: red, green and blue video information and a synchronization signal. These are combined to form a composite video signal.

This involves encoding the color data via a complex process known as color phase modulation. Noise (especially in the upper frequencies) is often introduced at this point. The composite video can further be used to modulate a high frequency carrier wave producing an RF video output that can be "understood" by the antenna leads of a standard TV set. In general, the further one gets from the original color and sync signals, the more encoding and decoding needed, and the noisier the signal.

A color look-up table (or mapping RAM) is a powerful tool built into some systems designed specifically with image processing in mind. Without the mapping RAM, each of the three color guns gets its intensity information directly from a bit or set of bits in memory. The color choice is predetermined and if a user wishes to change a color, new data must be loaded into the frame buffer.

A mapping RAM acts as liaison between the pixel data and the color guns. All of the bits representing a pixel are interpreted as an address to the mapping RAM, which is in the graphics interface. The contents of that address has the red, green and blue information

for the guns. This allows a large color menu as well as interactive color modification without redrawing parts of the image.

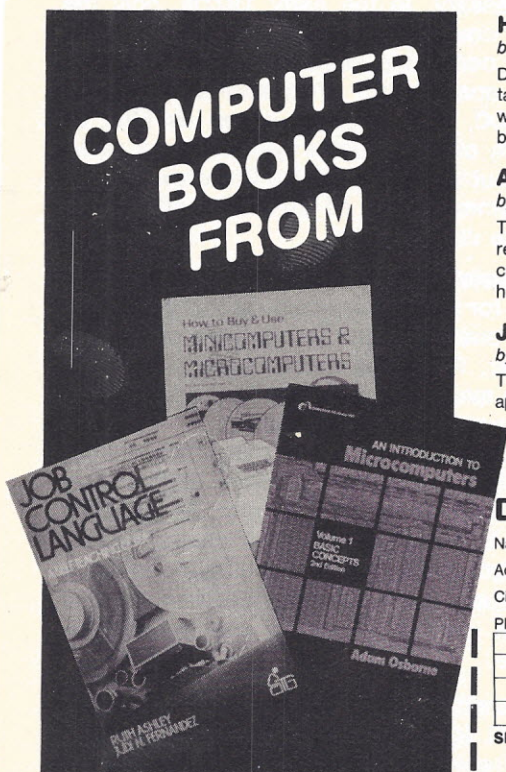
To automotive and aerospace design engineers, computer graphics is not a new concept. Back in the mid '60s, Ford Motor Co. began development of an interactive graphics system. What Ford used was a mini-computer host and a vector refresh display. Today its CAD configuration consists of precisely the same units.

The choice of vector refresh by many industrial designers comes about by a desire to combine certain features of both storage tube and raster scan displays. The interactive nature of design applications favors the raster, yet the resolution of the storage devices is desirable. Color is an expendable commodity in many CAD/CAM applications. Stroke writers meet these needs quite well.

Speed makes all the difference

Like the storage tube display, the stroke writer contains a deflection system capable of creating vectors by directly deflecting the writing beam between the endpoints. But the phosphor on the stroker more closely resembles the raster variety, requiring refresh. The structures making up a vector refresh CRT are essentially the same as those of a raster display: a writing gun cathode, control grid, a focusing system, electrostatic or electromagnetic x-y deflection apparatus and phosphor-coated screen.

The writing gun takes its directives from a display controller in much the same manner as the storage tube gun, but speed is a critical factor here since each vector must be refreshed at a rate to prevent flicker—



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30 times per second. The number of vectors that can be drawn is thus limited by the performance of the system, a problem that does not arise in raster graphics.

Furthermore, unlike storage tubes, a refresh display file must be readily accessible to the display controller. This continually polls the refresh buffer and performs complex transformations on this data before display. Many manufacturers of stroke writing systems offer display controllers ranging in intelligence from simple DMA devices to sophisticated processor-based 3-D simulators.

The early refresh displays used in Sketchpad plotted each vector point by point. The coordinate information for each point was stored in a refresh buffer. The process of drawing a vector involved computing points occurring along the vector, then entering the coordinates of these points in the refresh buffer. Soon however, hardware began to take over the computational responsibility for plotting the vectors, and only the end-point coordinates needed to be entered into the display list. This latter technique is employed by the true vector refresh devices today.

Although claims like "5000 vectors flicker free" are sometimes used to describe writing speed, a more precise measure is the speed in inches-per-second, both with the gun on and off. For example, typical writing rates are about 750,000 in/sec and a move rate (gun off) of twice this figure. At a refresh rate of 30 times per second, this means 2,500 10-in vectors or 25,000 1-in vectors each second.

Although color is not a natural for stroke writers, it is becoming common for manufacturers to offer a stroker with limited color capability. The method of generating

color is beam penetration whereby up to four phosphor layers on the screen backplate can radiate a different color when hit. By varying the beam intensity, the electrons will penetrate different depths into the phosphor layer resulting in one of two, three or four colors, depending on the number of phosphors present.

From the earliest efforts in graphics, a major design consideration has been to relieve the burden placed on the host computer by the graphics hardware. In an interactive setting, a decision must be made as to who gets priority: host or graphics interface. Generally, because of refresh requirements, the host must wait. This tends to slow down computations.

Megatek's graphics line is an example of a manufacturer offering variable local intelligence based on the user's requirements and wallet size. All models offer the ability to download an image from host and manipulate it locally from that point.

In the microcomputer field, Cromemco is trying to close the micro/mini performance gap by giving its graphics boards a bus of their own, which separates the graphics operations from the main CPU. A Hewlett-Packard product carries the localization procedure to extremes by severing all ties between the graphics terminal and the host. The HP system 45 is a desktop graphics computer that handles the Basic language itself, as well as the graphics manipulations.

The applications that computer graphics are finding can be categorized in different ways. The following breakdown represents one possibility.

Computer aided design: An aeronautics engineer can sit down at a console, simulate the effects of certain moving parts and make immediate design changes, if necessary. In the early 1970s, only the industrial giants could afford such equipment. Now, limited systems consisting of a CRT, floppy disks, digitizing tablet and control processor can be had for under \$50,000, and in some cases as little as \$15,000. Properly utilized, such a system can increase a designer's output six-fold. Detailed line drawings are the main requirement here, so strokers and refresh storage tubes are usually used.

Image processing: This covers the processing of satellite pictures for military, agricultural and geological purposes on the one hand, and the analysis of medical data on the other. While the former categories have been developing since the '60s, medical applications are a relatively recent and exciting area.

EEGs by video can be used in surgical monitoring, eliminating the time consuming process of after-the-fact analysis by experts in another city. At Stanford University, color imaging has been demonstrated as a useful tool for highlighting outputs of ultrasound scanning of heart tissues. Such systems require extensive color capabilities making raster the only technology readily applicable.

Process control: The past five years saw a gradual takeover of OAC (observation analysis and control) applications. Entire walls of dials and lights are replaced by a few color monitors. Process control often requires multiple color systems while special resolution remains a secondary consideration. Raster is usually the choice here. Other applications are computer aided manufacturing, management information systems, computer aided education and computer assisted animation. □

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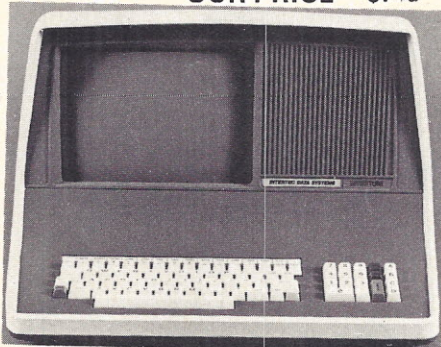
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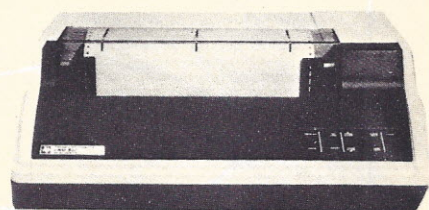
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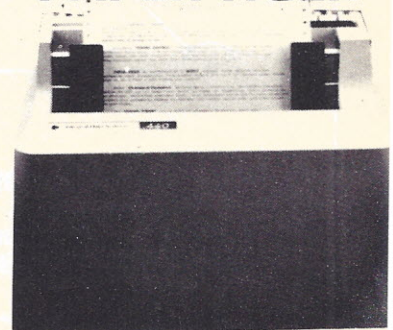


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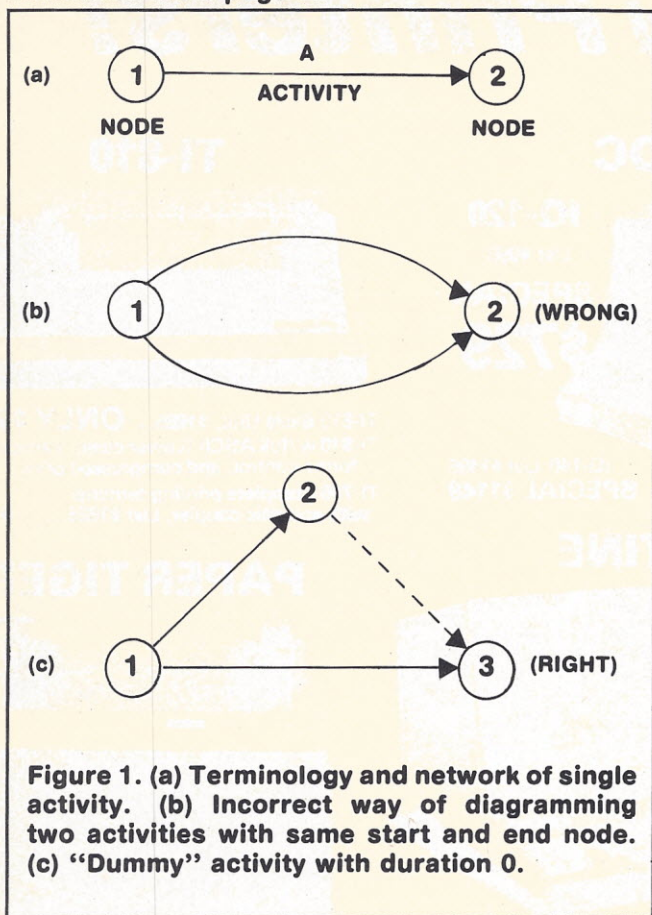


Figure 1. (a) Terminology and network of single activity. (b) Incorrect way of diagramming two activities with same start and end node. (c) "Dummy" activity with duration 0.

These equations are approximations; however they are widely accepted and yield satisfactory results.

Using the mean and standard deviation, complex calculations can estimate the project's duration. In a real size network, the computations are not only complex but monumental. Fortunately a technique called Monte Carlo or simulation can be employed.

Simulation, as it relates to the widget project, can best be described by a scenario. Assume you had to estimate the duration of a project that previously required 100 days. Should you need to estimate the duration of a similar project, you would be in an advantageous position. However, you could not know with certainty that the current project would also require 100 days.

Now assume you were involved in such a project on two occasions, and that durations were 100 days the first time and 97 days the second. You still cannot state the duration with certainty, but you would have more knowledge and therefore a better feel for variations in the project's duration.

Assume now that you were in charge of the project several hundred times. You could still not accurately state its duration but an analysis of the data reveals an exceptional estimate.

Simulation, in essence, allows one to reconstruct a project mathematically rather than actually. A "transaction" indicates each time a project is executed.

In the sample run, 140 transactions are analogous to constructing the project 140 times. The output shows the distribution of the durations from which an estimate can be derived. Obviously the more times a project is constructed, the more knowledge we have to make

future estimates. The upper limit to the number of transactions is the time the user is willing to wait for the results. Even for a computer, several million calculations takes a long time.

It is not clear whether a multiple-estimate approach (PERT) yields a better expected value for the project's duration than a one-estimate approach (CPM). For example in our project, the CPM analysis indicated that constructing the widget would require 100 minutes. The PERT analysis gives virtually identical results—between 97 and 100 minutes. PERT's strength lies in its ability to factor in variation in completion time. As will be seen from the histogram, the variability is easily ascertained.

Sample 2 shows how a program can be used for PERT analysis based on our widget project. The net-

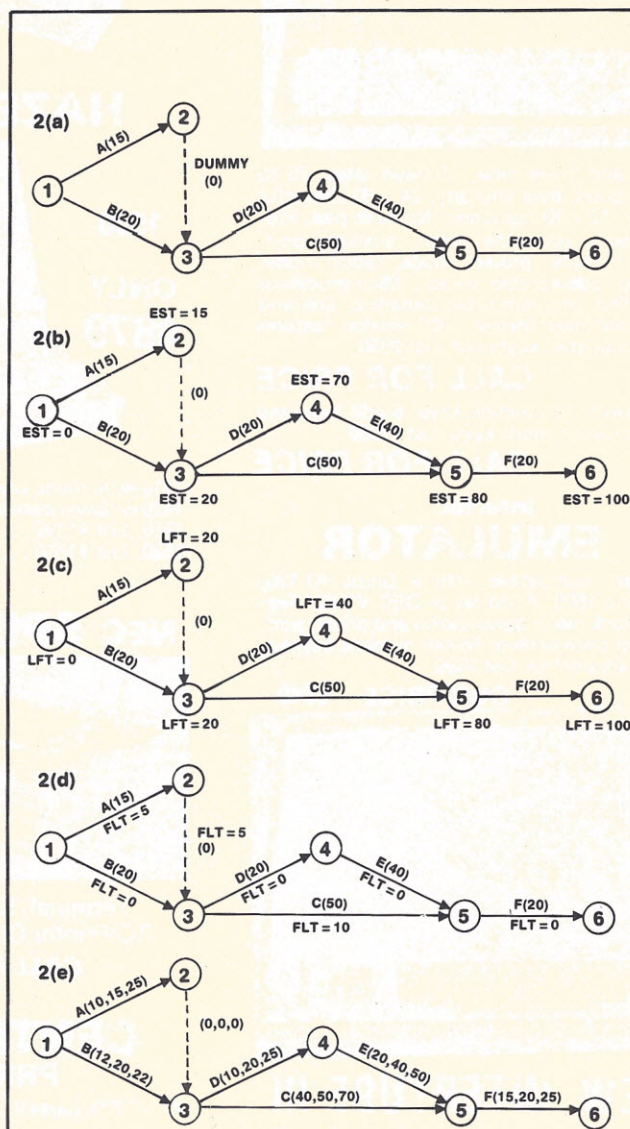


Figure 2. (a) Network for widget project. (b) First step of CPM algorithm requires calculation of earliest starting time for each event. (c) Latest finishing time for each event. (d) "Float" time values calculated. (e) Most optimistic, likely and pessimistic durations for each PERT activity.

work is in figure 2e, which is identical to figure 2a except that the most optimistic and most pessimistic durations are included.

After specifying the PERT option, the user supplies the start and end node of each activity as discussed under CPM. However the most likely, most optimistic, and most pessimistic durations for each activity must also be given. If the most likely value is 0, the program assumes the activity is a "dummy" and automatically sets the most optimistic and most pessimistic durations to 0.

The last bit of information needed is the number of transactions. Bare in mind that all activity durations are random variables and as such are subject to variation. By specifying a large number of transactions, the answer converges to the desired solution. The cost of using too many transactions is the execution time required by the program.

If the program is run on a large scale computer, the number of transactions is not of much concern. However, since the program is written in Basic and likely to be run on a micro, the number of transactions should

Sample 1. Shows how data is supplied to the CPM program, along with results.

```

RUN
CPM OR PERT SIMULATION (C/P) ? P
NUMBER OF ACTIVITIES? 7

ACTIVITY 1
FROM? 1
TO? 2
MOST LIKELY? 15
MOST OPTIMISTIC? 10
MOST PESSIMISTIC? 25

ACTIVITY 2
FROM? 1
TO? 3
MOST LIKELY? 20
MOST OPTIMISTIC? 12
MOST PESSIMISTIC? 22

ACTIVITY 3
FROM? 2
TO? 3
MOST LIKELY? 0

ACTIVITY 4
FROM? 3
TO? 4
MOST LIKELY? 20
MOST OPTIMISTIC? 10
MOST PESSIMISTIC? 25

ACTIVITY 5
FROM? 3
TO? 5
MOST LIKELY? 50
MOST OPTIMISTIC? 40
MOST PESSIMISTIC? 70

ACTIVITY 6
FROM? 4
TO? 5
MOST LIKELY? 40
MOST OPTIMISTIC? 20
MOST PESSIMISTIC? 50

ACTIVITY 7
FROM? 5
TO? 6
MOST LIKELY? 20
MOST OPTIMISTIC? 15
MOST PESSIMISTIC? 25
WOULD YOU LIKE TO EXAMINE OR EDIT THE INPUT DATA (Y/N)? Y

SORTING IN PROGRESS

ACTIVITY #   FROM   TO   ML   MU   MP
1           1       2    15   10   25
2           1       3    20   12   22
3           2       3     0    0    0
4           3       4    20   10   25
5           3       5    50   40   70
6           4       5    40   20   50
7           5       6    20   15   25

WOULD YOU LIKE TO EDIT AN ACTIVITY (Y/N)? N

SORTING IN PROGRESS

NUMBER OF TRANSACTIONS SHOULD BE >= 140
NUMBER OF TRANSACTIONS? 140
  
```

```

*** SIMULATION IN PROGRESS ***
*** SIMULATION IN PROGRESS *** 100
  
```

*** FREQUENCY DISTRIBUTION TABLE ***

```

MOST OPTIMISTIC PATH LENGTH 67
MOST PESSIMISTIC PATH LENGTH 125
NUMBER OF TRANSACTIONS LOWER THAN HISTOGRAM RANGE 0
NUMBER OF TRANSACTIONS HIGHER THAN HISTOGRAM RANGE 0
  
```

INTERVAL	FREQ.	PCT.
=> 64 < 67	0	0
=> 67 < 70	0	0
=> 70 < 73	1	1
=> 73 < 76	1	1
=> 76 < 79	2	1
=> 79 < 82	1	1
=> 82 < 85	3	2
=> 85 < 88	7	5
=> 88 < 91	5	4
=> 91 < 94	25	18
=> 94 < 97	24	17
=> 97 < 100	35	25
=> 100 < 103	17	12
=> 103 < 106	10	7
=> 106 < 109	7	5
=> 109 < 112	2	1
=> 112 < 115	0	0
=> 115 < 118	0	0
=> 118 < 121	0	0
=> 121 < 124	0	0

*** HISTOGRAM ***

RELATIVE FREQUENCY OF PATH LENGTHS

P	A	T	H	L	E	N	G	T	H
=> 64 < 67									
=> 67 < 70									
=> 70 < 73	*								
=> 73 < 76	*								
=> 76 < 79	**								
=> 79 < 82	*								
=> 82 < 85	****								
=> 85 < 88	*****								
=> 88 < 91	*****								
=> 91 < 94	*****								
=> 94 < 97	*****								
=> 97 < 100	*****								
=> 100 < 103	*****								
=> 103 < 106	*****								
=> 106 < 109	*****								
=> 109 < 112	**								
=> 112 < 115									
=> 115 < 118									
=> 118 < 121									
=> 121 < 124									

*** CP ACTIVITY ANALYSIS TABLE ***

ACTIVITY #	FROM	TO	CP FREQ.	PCT.
1	1	2	25	18
2	1	3	115	82
3	2	3	25	18
4	3	4	102	73
5	3	5	38	27
6	4	5	102	73
7	5	6	140	100

DUPLICATE CRITICAL PATHS OCCURED 0 TIMES.

WOULD YOU LIKE TO EDIT AN ACTIVITY OR STOP PROGRAM (E/S)? S

READY

be limited. Using a Southwest Technical Products micro, the widget project with 7 activities and 140 transactions required 3 minutes to execute. In many cases, the number of activities will be sufficiently large (i.e. >30), so the user will want to keep the number to a minimum. However, if too few transactions are specified, the random nature of the model will yield inaccurate data. As a rule of thumb, 20 times the number of activities should yield a reliable solution. As a check, rerun the program using a larger number of transactions. If the results are substantially different, it will be necessary to add more.

Before the simulation is performed, an interval for the histogram must be calculated. This allows data to be grouped, which means each outcome of a transaction need not be singly saved. This greatly reduces the required amount of memory.

The basis for the interval is the most optimistic and most pessimistic values supplied for each of the activities by the user. The sample run shows: 'most optimistic path length 67'. If every activity requires the most optimistic time, the project takes 67 minutes. In a similar manner, the sample run shows: 'most pessimistic path length 125'. In this case, the project takes 125 minutes. Using these two extreme values, 67 and 125, a range for the histogram is calculated at 64 and 124. It is unlikely that either of the two extremes will occur; however, it could. In fact, it is even possible for the project's duration to fall outside the range, but such occurrences are of little likelihood in the real world. However, for the sake of accuracy, the number of times the project falls outside this range—either low or high—is recorded. In our example, the project never required more than 124 minutes nor less than 64.

When the simulation is complete, the frequency distribution table shows the exact frequency for each interval. Such data cannot be ascertained from the histogram alone. In addition to the absolute frequency, the percentage is given. For example, of 140 transactions, 35 fell in the 97 to 100 interval. This represents 25% of the total number of transactions.

From this we can deduce that the project will require approximately 98 minutes based on the high frequency of the 97 to 100 minute interval. To play it safe, a project manager may specify a range. In our example, it will take 91 to 100 minutes—98 minutes being the most likely.

Note several apparent anomalies. If one were to strictly interpret the output data, the project is more likely to require between 85 and 88 minutes rather than between 88 and 91 minutes. This is obviously not likely; it merely shows the random nature of the simulation when the number of transactions and activities is small.

Even more important is finding those activities most critical to the project. This can be gained from the CP activity analysis table, which shows that activity 2 (nodes 1 to 3) occurred on the critical path 82% of the time. If a project manager can schedule resources to expedite the project, this activity would be one of the first to receive attention. Activity 4 (nodes 3 to 4) and activity 6 (nodes 4 to 5) also occurred on the critical path frequently, namely 78% of the time. These activities would also receive special attention.

Note that it is not a coincidence that activities 4 and 6 occurred on the critical path with the same frequency,

namely 102 times. An examination of the network shows that these two activities lie on the same path and, therefore, must have identical frequency values. In a similar vein, it is not surprising to find that the frequencies for activities 1 and 2 total 140 (25 + 115), which is equal to the total number of transactions. This occurs because activity 1 cannot be on the critical path with 2, and vice versa. The total must equal the total number of transactions. □

Sample 2. Input and output of Pert program. Data is supplied in a manner similar to CPM program, however three activity durations are required instead of one.

```

RUN
CPM OR PERT SIMULATION (C/P) ? C
NUMBER OF ACTIVITIES? 7

ACTIVITY 1
FROM? 1
TO? 2
DURATION? 15

ACTIVITY 2
FROM? 1
TO? 3
DURATION? 20

ACTIVITY 3
FROM? 2
TO? 3
DURATION? 0

ACTIVITY 4
FROM? 3
TO? 4
DURATION? 20

ACTIVITY 5
FROM? 3
TO? 5
DURATION? 50

ACTIVITY 6
FROM? 4
TO? 5
DURATION? 40

ACTIVITY 7
FROM? 5
TO? 6
DURATION? 20
WOULD YOU LIKE TO EXAMINE OR EDIT THE INPUT DATA (Y/N)? Y

SORTING IN PROGRESS

ACTIVITY #    FROM    TO    DURATION
1             1       2       15
2             1       3       20
3             2       3        0
4             3       4       20
5             3       5       50
6             4       5       40
7             5       6       20
WOULD YOU LIKE TO EDIT AN ACTIVITY (Y/N)? N

SORTING IN PROGRESS
CP ANALYSIS IS:

FROM    TO    EST    LFT    FLOAT
1       2      0      20     5
1       3      0      20     0
2       3     15      20     5
3       4     20      40     0
3       5     20      80    10
4       5     40      80     0
5       6     80     100     0

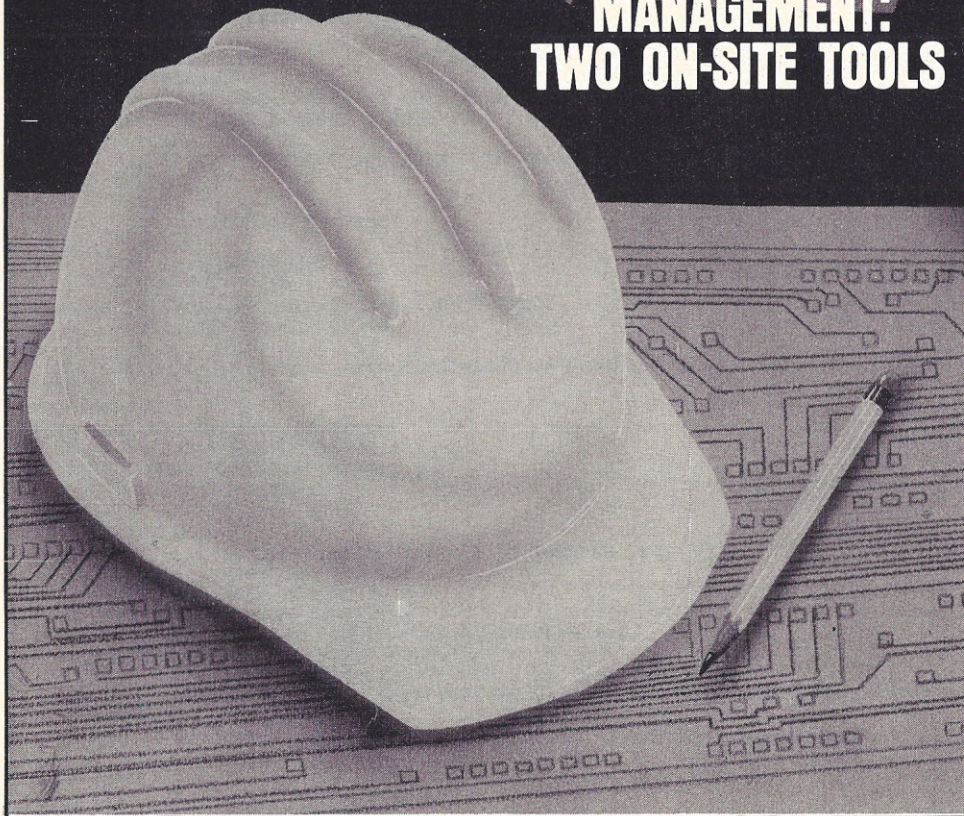
THE CRITICAL PATH LENGTH IS 100

THE CRITICAL PATH IS:
FROM    TO
1       3
3       4
4       5
5       6

WOULD YOU LIKE TO EDIT AN ACTIVITY OR STOP PROGRAM (E/S)? S
READY

```

HARD-HAT MANAGEMENT: TWO ON-SITE TOOLS



Listing 1. Basic source listing for CPM and Pert programs.

```

10 REM * INITIALIZE NORMAL DISTRIBUTION CONSTANTS
20 RN=15 : RS=SQR(3/RN)
30 REM *****
40 REM * INPUT DATA *
50 REM *****
60 INPUT "CPM OR PERT SIMULATION (C/P) "; Q$
70 INPUT "NUMBER OF ACTIVITIES"; N
90 DIM ML(N), MO(N), MP(N), CP(N), ME(N), SD(N), IC(20)
90 DIM S(N), F(N), D(N), E(N), L(N), F1(N)
100 FOR I=1 TO N
110 PRINT : PRINT "ACTIVITY"; I
120 REM * GO TO INPUT DATA ROUTINE
130 GOSUB 1920

```

```

140 NEXT I
150 INPUT "WOULD YOU LIKE TO EXAMINE OR EDIT THE INPUT DATA (Y/N)"; Q1$
160 IF LEFT$(Q1$,1)="N" THEN 430
170 REM * SORT INPUT DATA
180 GOSUB 2080
190 REM *****
200 REM * DISPLAY INPUT DATA *
210 REM *****
220 IF LEFT$(Q$,1)<>"C" THEN 280
230 PRINT "ACTIVITY # FROM TO DURATION"
240 FOR I=1 TO N
250 PRINT TAB(5); I; TAB(15); S(I); TAB(25); F(I); TAB(35); D(I)
260 NEXT I
270 GOTO 340
280 PRINT "ACTIVITY # FROM TO ML MO MP"
290 FOR I=1 TO N
300 PRINT TAB(5); I; TAB(15); S(I); TAB(25); F(I);
310 PRINT TAB(35); ML(I); TAB(45); MO(I); TAB(55); MP(I)
320 NEXT I
330 PRINT
340 INPUT "WOULD YOU LIKE TO EDIT AN ACTIVITY (Y/N)"; Q1$
350 IF LEFT$(Q1$,1)="N" THEN 430
360 REM * EDIT MODE *
370 PRINT : INPUT "WHAT ACTIVITY NEEDS TO BE ALTERED (0 TO END)"; I
380 IF I=0 THEN 150
390 REM * GO TO INPUT DATA ROUTINE
400 GOSUB 1920
410 GOTO 370
420 REM * GO TO SORT ROUTINE
430 GOSUB 2080
440 IF LEFT$(Q$,1)<>"C" THEN 760
450 REM *****
460 REM * CRITICAL PATH ANALYSIS REQUESTED. PERFORM CRITICAL PATH *
470 REM * ANALYSIS ONCE AND DISPLAY RESULTS. *
480 REM *****
490 GOSUB 2340
500 C2=0
510 PRINT : PRINT "CP ANALYSIS IS:"
520 PRINT : PRINT : PRINT "FROM","TO","EST","LFT","FLOAT" : PRINT
530 FOR I=1 TO N
540 PRINT S(I),F(I),E(S(I)),L(F(I)),F1(I)
550 NEXT I
560 PRINT "THE CRITICAL PATH LENGTH IS "; PL
570 PRINT : PRINT "THE CRITICAL PATH IS:" : PRINT "FROM","TO":PRINT
580 FOR I=1 TO N
590 IF F1(I)=0 THEN 610
600 NEXT I
610 PRINT S(I),F(I) : C2=C2+1 : IF I>N THEN 650
620 FOR M=1 TO N
630 IF S(M)=F(I) AND F1(M)=0 THEN I=M : GOTO 610
640 NEXT M
650 IF C1<>C2 THEN PRINT "THERE IS MORE THAN ONE CRITICAL PATH"
660 PRINT
670 INPUT "WOULD YOU LIKE TO EDIT AN ACTIVITY OR STOP PROGRAM (E/S)"; Q1$
680 IF LEFT$(Q1$,1)="E" THEN PRINT : GOTO 220
690 END
700 REM *****
710 REM * PERT SIMULATION REQUESTED. PERFORM CRITICAL PATH ANALYSIS THE *
720 REM * NUMBER OF TIMES SPECIFIED. STORE PATH LENGTHS AND INCREMENT *
730 REM * ACTIVITIES WHICH APPEAR ON CRITICAL PATH. CONSTRUCT HISTOGRAM *
740 REM * AND DISPLAY RESULTS. *
750 REM *****

```

```

*****
ABLE *
*****
DISTRIBUTION TABLE *** : PRINT
$ BC
$ WC

```

```

0400 PRINT "NUMBER OF TRANSACTIONS LOWER THAN HISTOGRAM RANGE "; LS
1410 PRINT "NUMBER OF TRANSACTIONS HIGHER THAN HISTOGRAM RANGE "; HS : PRINT
1420 PRINT "          INTERVAL          FREQ.          PCT."
1430 I1=LL-IN ; I2=LL
1440 FOR M=1 TO 20
1450   PRINT ">" ; I1; "<" ; I2; TAB(20); IC(M); TAB(30); INT(.5+100*IC(M)/NS)
1460   I1=I1+IN ; I2=I2+IN
1470 NEXT M
1480 REM *****
1490 REM * PRINT HISTOGRAM *
1500 REM *****
1510 REM * COMPUTE HISTOGRAM SCALE FACTOR
1520 SC=0 ; LO=18 ; J=0 ; LL=INT(RC)
1530 FOR M=1 TO 20
1540   IF IC(M)>SC THEN SC=IC(M)
1550 NEXT M
1560 SC=50/SC
1570 X$="PATH LENGTH"
1580 PRINT : PRINT : PRINT TAB(24); "*** HISTOGRAM ***" ; PRINT
1590 PRINT TAB(18); "RELATIVE FREQUENCY OF PATH LENGTHS"
1600 PRINT TAB(LO); "+-----+-----+-----+"
1610 FOR M=1 TO 20
1620   HM=IC(M) * SC
1630   FOR K=1 TO 3
1640     J=J+1 ; PRINT MID$(X$,J,1); TAB(2);
1650     IF K=2 THEN PRINT ">" ; LL-IN; "<" ; LL ; LL=LL+IN
1660     PRINT TAB(LO);
1670     IF IC(M)=0 THEN PRINT : GOTO 1720
1680     FOR I=1 TO HM
1690       PRINT "*";
1700     NEXT I
1710     PRINT
1720   NEXT K
1730 NEXT M
1740 REM *****
1750 REM * PRINT ACTIVITY ANALYSIS *
1760 REM *****
1770 PRINT : PRINT
1780 PRINT TAB(10); "*** CP ACTIVITY ANALYSIS TABLE ***" : PRINT
1790 PRINT "ACTIVITY #      FROM      TO      CP FREQ.    PCT."
1800 FOR I=1 TO N
1810   PRINT TAB(5); I; TAB(15); S(I); TAB(25); F(I);
1820   PRINT TAB(35); CP(I); TAB(45); INT(.5+100*CP(I)/NS)
1830 NEXT I
1840 PRINT : PRINT "DUPLICATE CRITICAL PATHS OCCURED"; DU; "TIMES."
1850 PRINT
1860 INPUT "WOULD YOU LIKE TO EDIT AN ACTIVITY OR STOP PROGRAM (E/S)"; Q1$
1870 IF LEFT$(Q1$,1)="E" THEN PRINT : GOTO 220
1880 END
1890 REM *****
1900 REM * INPUT DATA ROUTINE *
1910 REM *****
1920 INPUT "FROM"; S(I)
1930 INPUT "TO"; F(I)
1940 IF F(I)>N THEN PRINT "*** END NODE # NOT <= # OF ACTIVITIES ***":GOTO1930
1950 IF S(I)>=F(I) THEN PRINT "*** START NODE MUST BE < END NODE ***":GOTO1920
1960 IF LEFT$(Q$,1)="C" THEN INPUT "DURATION"; D(I) ; GOTO 2040
1970 INPUT "MOST LIKELY"; ML(I)
1980 REM * CHECK FOR DUMMY ACTIVITY
1990 IF ML(I)=0 THEN MO(I)=0 ; MP(I)=0 ; GOTO 2040
2000 INPUT "MOST OPTIMISTIC"; MO(I)
2010 IF MO(I)>ML(I) THEN PRINT "*** MO MUST BE <= ML ***" ; GOTO 2000
2020 INPUT "MOST PESSIMISTIC"; MP(I)
2030 IF MP(I)<ML(I) THEN PRINT "*** MP MUST BE >= ML ***" ; GOTO 2020

```

```

2040 RETURN *****
2050 REM ***** SORT DATA USING START MODE AS KEY *****
2060 REM *****
2070 REM *****
2080 PRINT : PRINT "SORTING IN PROGRESS" : PRINT
2090 SW=0
2100 FOR I=1 TO N-1
2110 J=I+1
2120 IF S(I)<S(J) THEN 2200
2130 EX=S(I) : S(I)=S(J) : S(J)=EX
2140 EX=F(I) : F(I)=F(J) : F(J)=EX
2150 EX=D(I) : D(I)=D(J) : D(J)=EX
2160 EX=ML(I) : ML(I)=ML(J) : ML(J)=EX
2170 EX=MO(I) : MO(I)=MO(J) : MO(J)=EX
2180 EX=MP(I) : MP(I)=MP(J) : MP(J)=EX
2190 SW=1
2200 NEXT J
2210 IF SW=1 THEN 2090
2220 RETURN

```

```

2230 REM ***** THE FOLLOWING SUBROUTINE IS USED BY BOTH THE CPM ANALYSIS *****
2240 REM ***** AS WELL AS THE PERT SIMULATION ANALYSIS. WHILE THE CPM *****
2250 REM ***** ANALYSIS CALLS THIS ROUTINE ONLY ONCE, THE SIMULATION *****
2260 REM ***** CALLS THIS ROUTINE THE NUMBER OF TIMES REQUESTED BY THE *****
2270 REM ***** USER. THE EARLIEST, LATEST, AND FLOAT TIMES ARE COMPUTED *****
2280 REM ***** AND FROM THIS DATA THE CRITICAL PATH LENGTH AND CRITICAL *****
2290 REM ***** PATH ARE CALCULATED. DUPLICATE CRITICAL PATHS ARE ONLY *****
2300 REM ***** COUNTED ONCE. *****
2310 REM *****
2320 REM ***** COMPUTE EARLIEST STARTING TIME *****
2330 REM *****
2340 C1=0 : C2=0 : PL=0
2350 FOR I=1 TO N
2360 M1=E(S(I)) + B(I)
2370 IF E(F(I))<M1 THEN E(F(I))=M1
2380 NEXT I
2390 REM ***** COMPUTE LATEST FINISHING TIME *****
2400 L(F(N))=E(F(N))
2410 FOR I=N TO 1 STEP -1
2420 L1=S(I) : M2=L(F(I))-B(I)
2430 IF L(L1)>M2 OR L(L1)=0 THEN L(L1)=M2
2440 NEXT I
2450 REM ***** COMPUTE FLOAT TIME *****
2460 FOR I=1 TO N
2470 F1(I)=L(F(I))-E(S(I))-B(I)
2480 IF F1(I)<.0001 THEN F1(I)=0 : C1=C1+1
2490 NEXT I
2500 REM ***** COMPUTE CRITICAL PATH LENGTH *****
2510 FOR I=1 TO N
2520 IF L(F(I))>PL THEN PL=L(F(I))
2530 NEXT I
2540 REM ***** COMPUTE CRITICAL PATH *****
2550 FOR I=1 TO N
2560 IF F1(I)=0 THEN 2580
2570 NEXT I
2580 C2=C2+1 : CP(I)=CP(I)+1
2590 IF I>N THEN 2630
2600 FOR M=1 TO N
2610 IF S(M)=F(I) AND F1(M)=0 THEN I=M : GOTO 2580
2620 NEXT M
2630 IF C1>C2 THEN RU=RU+1
2640 RETURN

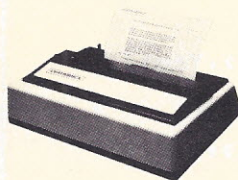
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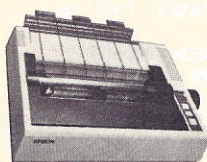


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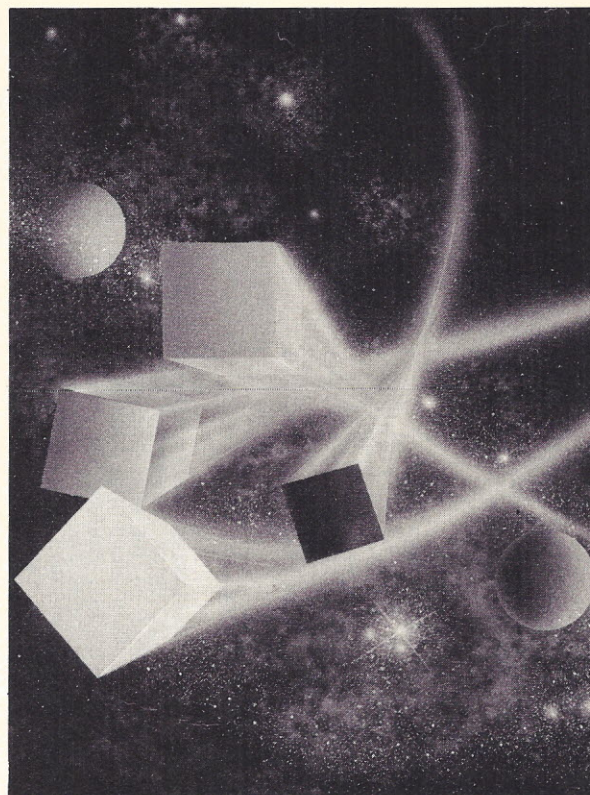
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Microcomputing at the Speed of Light
Continued from page 76



```

2030   FOR J1 = 0 TO 10
2040   YR = J1 * 10
2050   Y2 = YR * YR
2060   Y(J1) = 159 - YR
2070   FOR I1 = 0 TO 1
2080   XR = 10 * I1 + X0
2090   XA = (XR - RV * SQR (XR
* XR + Y2)) / LC
2100   IF XA < - 200 THEN XA =
- 200
2110   X(I1,J1) = XA + 200
2120   NEXT
2130   NEXT
2140   REM PLOT NEW CARPET
2150   HGR : HCOLOR= 7
2160   HPLOT X(1,0),159
2170   FOR J1 = 0 TO 10
2180   HPLOT TO X(0,J1),Y(J1)
2190   NEXT
2200   FOR J1 = 10 TO 0 STEP - 1

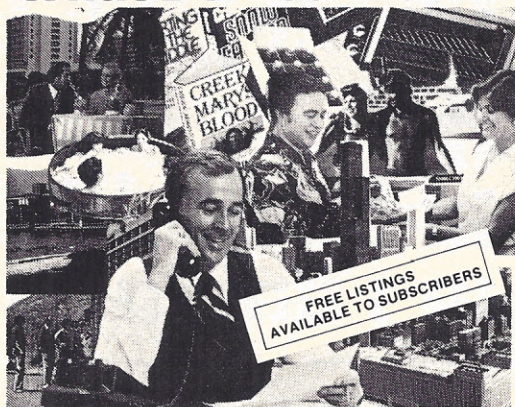
2210   HPLOT TO X(1,J1),Y(J1)
2220   NEXT
2230   IF PEEK ( - 16384) > 127 THEN
1030: REM CHECK KEYBOARD
2240   NEXT X0: GOTO 2010
3000   REM STREET LIGHT PATTERN
3010   HGR : HCOLOR= 7
3020   FOR J1 = 0 TO 14
3030   YR = J1 * 10:Y2 = YR * YR
3040   FOR I1 = 0 TO 18
3050   XR = 10 * I1 - 101
3060   XA = (XR - RV * SQR (XR *
XR + Y2)) / LC
3070   IF XA < - 199 THEN 3090
3080   HPLOT XA + 200,159 - YR
3090   NEXT
3100   IF PEEK ( - 16384) > 127 THEN
1030: REM CHECK KEYBOARD
3110   NEXT : GOTO 1160
9999   TEXT : HOME : END
    
```

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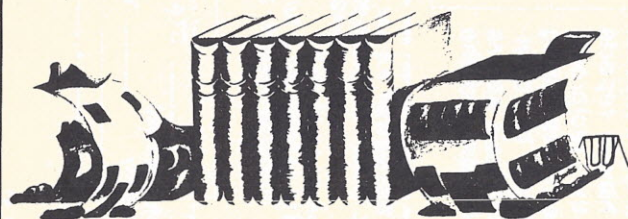
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CIRCLE INQUIRY NO. 61

Continued from page 95

Information Source for Home and School



PROGRAM LISTING

LIST

```

10 REM *****
20 REM ARTICLE INFORMATION STORAGE
   REM INITIALIZING AND PROGRAM
30 REM DEVELOPED BY K.N.SCHLARB
40 REM WORTHINGTON, OHIO *****
   REM **
50 REM ARTICLE INFORMATION INITI-
   REM ALIZING ROUTINE
60 D$ = CHR$(4): REM CTRL D
70 PRINT D$;"NOMON I,O,C"
80 HOME
90 INPUT "WHAT IS THE INFORMATION
   REM TO BE STORED ON THIS DISK
   REM ";NAME$
100 PRINT D$;"OPEN NAME$,L45"
110 PRINT D$;"WRITE NAME$,R1"

```

```

160 PRINT TAB(10)"1.INPUT INFORMATION"
170 PRINT TAB(10)"2.OUTPUT INFORMATION"
180 PRINT TAB(10)"3.STOP WORK"
   REM ";PRINT
190 INPUT "WHAT IS YOUR CHOICE "
   REM ";Z
200 ON Z GOTO 210,760,2230
210 HOME:PRINT:PRINT "YOUR SECOND
   REM CHOICE"
220 PRINT:PRINT "1. ENTER NEW INFORMATION"
230 PRINT "2.CHANGE CURRENT INFORMATION"
240 PRINT:INPUT "WHAT DO YOU WISH
   REM ";Z
250 ON Z GOTO 260,460
260 GOSUB 1830
270 HOME:PRINT:PRINT "THE LAST
   REM SUBJECT ID. # ENTERED WAS ";A
280 PRINT:PRINT:INPUT "ENTER NEW
   REM ID.#";A
290 PRINT:PRINT "ENTER THE SUBJECT
   REM OF THE NEW "
300 PRINT "ARTICLE AND ITS ID.#"

310 PRINT:INPUT SUBJECT$
320 IF LEN(SUBJECT$) > 19 THEN
   PRINT:PRINT CHR$(7):PRINT
   REM CHR$(7):PRINT "LENGTH TOO
   REM LONG:":INVERSE:PRINT "REENTER
   REM SUBJECT/ID.# IN SHORTER
   REM FORM.":NORMAL:GOTO 310
330 PRINT:PRINT "ENTER AUTHOR
   REM NAME,ID.#"
340 PRINT:INPUT AUTH$
350 IF LEN(AUTH$) > 19 THEN PRINT
   REM :PRINT CHR$(7):PRINT CHR$(
   REM 7):PRINT "LENGTH TOO LONG:"
   REM :INVERSE:PRINT "REENTER A
   REM UTHOR/ID.# IN SHORTER FORM."
   REM :NORMAL:GOTO 340
360 PRINT:PRINT "ENTER THE ARTI-
   REM CLE TITLE,DATE,PAGE,ID.#"
370 PRINT
380 INPUT TITLE$
390 IF LEN(TITLE$) > 54 THEN PRINT
   REM :PRINT CHR$(7):PRINT CHR$(

```

```

   REM "ENTER NEW TITLE,DATE,PAGES,
   REM ID.#":PRINT
670 INPUT TITLE$
680 PRINT:PRINT "DO YOU WISH TO
   REM MAKE ANOTHER CHANGE"
690 INPUT "IN THIS SUBJECT ";C$

700 IF C$ = "Y" OR C$ = "YES" THEN
   REM 550
710 GOSUB 1640
720 HOME:PRINT "DO YOU WANT TO
   REM CHANGE ITEMS"
730 INPUT "IN ANOTHER SUBJECT ";
   REM C$
740 IF C$ = "Y" OR C$ = "YES" THEN
   REM 460
750 GOTO 90
760 REM OUTPUT INFORMATION CHOICE
770 HOME:PRINT:PRINT "ENTER YOUR
   REM CHOICE"
780 PRINT
790 PRINT "1. SEARCH BY SUBJECT,
   REM AUTHOR,OR TITLE"
800 PRINT
810 PRINT "2. RECEIVE SUBJECT,AU-
   REM THOR,TITLE":PRINT "FOR SPEC-
   REM IFIC ID.#"
820 PRINT:INPUT Z:HOME:PRINT

830 ON Z GOTO 840,1470
840 REM DO SEARCH
850 PRINT "DO YOU WANT TO SEARCH
   REM BY SUBJECT (1) "
860 PRINT "AUTHOR (2) OR TITLE (
   REM 3)"
870 INPUT Z
880 ON Z GOTO 890,1100,1270
890 HOME:REM SUBJECT SEARCH
900 GOSUB 1830
910 PRINT "HOW MANY LETTERS DO YOU
   REM WISH TO USE":INPUT "IN THE
   REM SUBJECT SEARCH ";X
920 IF X < 1 THEN 910
930 GOSUB 2200
940 PRINT:PRINT "WHAT ";C$(3);
   REM " THE FIRST ";X;" ";C$(4);
   REM " YOU"
950 INPUT "WISH TO USE IN THE SUB-
   REM JECT SEARCH ";B$

```

```

120 PRINT NAME$
130 PRINT D$;"CLOSE NAME$"
140 F$ = "LZ":L = 3:I = 1
150 GOSUB 320
160 F$ = "ISSUE$":L = 20:I = 1
170 GOSUB 320
180 F$ = "SUBJECT$":L = 20
190 GOSUB 250
200 F$ = "AUTHOR$":L = 20
210 GOSUB 250
220 F$ = "TITLE$":L = 55
230 GOSUB 250
240 END
250 PRINT D$;"OPEN";F$;"L";L
260 FOR I = 1 TO 900
270 PRINT D$;"WRITE";F$;"R";I
280 PRINT " "
290 NEXT I
300 PRINT D$;"CLOSE";F$;" "
310 RETURN
320 PRINT D$;"OPEN";F$;"L";L
330 PRINT D$;"WRITE";F$;"R";I
340 PRINT " "
350 PRINT D$;"CLOSE";F$;" "
360 RETURN

```

```

JCATALOGPR#0
JLIST

```

```

10 REM *****
20 REM ARTICLE INFORMATION
30 REM STORAGE MAIN PROGRAM
40 REM *****
50 D$ = CHR$(4): REM CTRL D
60 DIM A$(200)
70 PRINT " "; "NOMON I,O,C"
80 GOSUB 1950
90 HOME : PRINT : PRINT NAME$: PRINT

100 GOSUB 1830
110 PRINT : PRINT : PRINT "THERE
    ARE PRESENTLY ";A$;" ARTICLE
    S ON": PRINT "THIS DISK."
120 GOSUB 2010
130 PRINT : PRINT "THE DATE OF T
    HE MOST CURRENT ARTICLE": PRINT
    "IS ";ISSUE$
140 PRINT : PRINT : PRINT
150 PRINT "YOU HAVE THREE OPTION
    S"

```

```

(7): PRINT "LENGTH TO LONG:"
: INVERSE : PRINT "REENTER T
ITLE/DATE/PAGE/ID.# IN": PRINT
"SHORTER FORM.": NORMAL : GOTO
380
400 GOSUB 1640
410 GOSUB 1890
420 HOME : PRINT : PRINT "DO YOU
    WISH TO ENTER INFORMATION":
    PRINT "FOR ANOTHER ARTICLE"

430 PRINT : INPUT C$
440 IF C$ = "Y" OR C$ = "YES" THEN
    270
450 HOME : PRINT "ENTER THE DATE
    OF THE MOST RECENT DATED": PRINT
    : INPUT "MATERIAL. ";ISSUE$:
    GOSUB 1780: GOTO 90
460 PRINT : PRINT "WHICH SUBJECT
    NUMBER DO YOU "
470 PRINT "WISH TO CHANGE"
480 INPUT A
490 GOSUB 2060
500 HOME : PRINT
510 PRINT "SUBJECT : "SUBJECT$
520 PRINT : PRINT "AUTHOR: ";AUT
    H$
530 PRINT : PRINT "TITLE : "TITL
    E$
540 PRINT
550 PRINT : PRINT "WHAT DO YOU W
    ANT TO CHANGE SUBJECT (1)"
560 INPUT "AUTHOR (2) OR TITLE (
    3) ";Z
570 ON Z GOTO 580,620,660
580 HOME : PRINT "PRESENT SUBJEC
    T: ";SUBJECT$: PRINT : PRINT
    : PRINT "ENTER NEW SUBJECT A
    ND ID.#"
590 PRINT
600 INPUT SUBJECT$
610 GOTO 680
620 HOME : PRINT "PRESENT AUTHOR
    : ";AUTH$: PRINT : PRINT : PRINT
    "ENTER NEW AUTHOR AND ID.#"
630 PRINT
640 INPUT AUTH$
650 GOTO 680
660 HOME : PRINT "PRESENT TITLE:
    ";TITLE$: PRINT : PRINT : PRINT

```

```

960 HOME : PRINT
970 HOME : J = 1
980 PRINT D$;"OPEN SUBJECT$,L20"

990 FOR I = 1 TO A
1000 PRINT D$;"READ SUBJECT$,R";
    I
1010 INPUT E$
1020 IF LEFT$(E$,X) = B$ THEN
    A$(J) = E$:J = J + 1
1030 NEXT I
1040 PRINT D$;"CLOSE SUBJECT$"
1050 PRINT :K = 0: FOR I = 1 TO
    J - 1: PRINT A$(I): PRINT :K
    = K + 1: IF K = 8 THEN PRINT
    "TYPE 'Y' TO CONTINUE": GET
    Z$:K = 0: HOME : PRINT
1060 NEXT I: GOSUB 3000
1070 PRINT : INPUT "DO YOU WANT
    ANOTHER SUBJECT SEARCH ";C$:
    IF C$ = "Y" OR C$ = "YES" THEN
    910
1080 GOTO 1450
1090 GOTO 80
1100 HOME : REM AUTHOR SEARCH
1110 GOSUB 1830
1120 PRINT : PRINT "HOW MANY LET
    TERS DO YOU WISH TO USE": INPUT
    "IN THE AUTHOR SEARCH ";X: IF
    X < 1 THEN 1120
1130 GOSUB 2200: PRINT : PRINT "
    WHAT ";C$(3);" THE FIRST ";X
    ;" ";C$(4);" YOU"
1140 INPUT "WISH TO USE IN THE A
    UTHOR SEARCH ";B$
1150 HOME : J = 1
1160 PRINT D$;"OPEN AUTHOR$,L20"

1170 FOR I = 1 TO A
1180 PRINT D$;"READ AUTHOR$,R";I
1190 INPUT E$
1200 IF LEFT$(E$,X) = B$ THEN
    A$(J) = E$:J = J + 1
1210 NEXT I
1220 PRINT D$;"CLOSE AUTHOR$"
1230 PRINT :K = 0: FOR I = 1 TO
    J - 1: PRINT A$(I): PRINT :K
    = K + 1: IF K = 8 THEN PRINT
    "TYPE 'Y' TO CONTINUE": GET
    Z$:K = 0: HOME : PRINT

```

```

1240 NEXT I: GOSUB 3000
1250 PRINT : INPUT "DO YOU WANT
ANOTHER AUTHOR SEARCH ";C$: IF
C$ = "Y" OR C$ = "YES" THEN
1120
1260 GOTO 1450
1270 HOME : REM TITLE SEARCH
1280 GOSUB 1830
1290 PRINT "HOW MANY LETTERS DO
YOU WISH TO USE": INPUT "IN
THE TITLE SEARCH ";X: IF X <
1 THEN 1290
1300 GOSUB 2200: PRINT : PRINT "
USE THE FIRST ";X;" ";C$(4);
" OF THE": PRINT "FIRST MAJO
R WORD."
1310 PRINT : PRINT "WHAT ";C$(3)
;" THE FIRST ";X;" ";C$(4);"
YOU"
1320 INPUT "WISH TO USE IN THE T
ITLE SEARCH ";B$
1330 HOME :J = 1
1340 PRINT D$;"OPEN TITLE$,L55"
1350 FOR I = 1 TO A
1360 PRINT D$;"READ TITLE$,R";I
1370 INPUT E$
1380 IF LEFT$(E$,X) = B$ THEN
A$(J) = E$:J = J + 1
1390 NEXT I
1400 PRINT D$;"CLOSE TITLE$"
1410 PRINT :K = 0: FOR I = 1 TO
J - 1: PRINT A$(I): PRINT :K
= K + 1: IF K = 8 THEN PRINT
"TYPE 'Y' TO CONTINUE": GET
Z$:K = 0: HOME : PRINT
1420 NEXT I: GOSUB 3000
1430 PRINT : INPUT "DO YOU WANT
ANOTHER TITLE SEARCH ";C$
1440 IF C$ = "Y" OR C$ = "YES" THEN
HOME : GOTO 1290
1450 HOME : PRINT "DO YOU WISH T
O MAKE A DIFFERENT SEARCH": INPUT
C$: IF C$ = "Y" OR C$ = "YES"
THEN 850
1460 GOTO 80
1470 REM PRINT SUBJECT,AUTHOR,T
ITLE ACCORDING TO TITLE
1480 HOME : PRINT : PRINT "WHAT
IS THE ID. NUMBER OF THE"

```

```

1490 PRINT "SUBJECT/AUTHOR/TITLE
FOR WHICH YOU"
1500 INPUT "WANT INFORMATION ";A
1510 HOME : GOSUB 2060
1520 PRINT : PRINT : PRINT
1530 PRINT "SUBJECT : "SUBJECT$
1540 PRINT : PRINT "AUTHOR: ";AU
TH$
1550 PRINT : PRINT "TITLE : "TIT
LE$
1560 PRINT : PRINT : PRINT
1570 PRINT
1580 PRINT "DO YOU WANT A COPY O
F ANOTHER"
1590 PRINT "SUBJECT/AUTHOR/TITLE
SET"
1600 PRINT
1610 INPUT "NOTE:YOU MUST KNOW T
HE ID.NUMBER ";C$
1620 IF C$ = "Y" OR C$ = "YES" THEN
1480
1630 GOTO 90
1640 REM WRITE IN INFORMATION
1650 PRINT D$;"OPEN SUBJECT$,L20
"
1660 PRINT D$;"WRITE SUBJECT$,R"
;A
1670 PRINT SUBJECT$
1680 PRINT D$;"CLOSE SUBJECT$"
1690 PRINT D$;"OPEN TITLE$,L55"
1700 PRINT D$;"WRITE TITLE$,R";A
1710 PRINT TITLE$
1720 PRINT D$;"CLOSE TITLE$"
1730 PRINT D$;"OPEN AUTHOR$,L20"
1740 PRINT D$;"WRITE AUTHOR$,R";
A
1750 PRINT AUTH$
1760 PRINT D$;"CLOSE AUTHOR$"
1770 RETURN
1780 PRINT D$;"OPEN ISSUE$,L20"
1790 PRINT D$;"WRITE ISSUE$,R1"
1800 PRINT ISSUE$
1810 PRINT D$;"CLOSE ISSUE$"
1820 RETURN
1830 REM FIND LAST ARTICLE NO.
INPUT

```

```

1840 PRINT D$;"OPEN LZ,L3"
1850 PRINT D$;"READ LZ,R1"
1860 INPUT A
1870 PRINT D$;"CLOSE LZ"
1880 RETURN
1890 REM RECORD LAST ARTICLE NO
INPUT
1900 PRINT D$;"OPEN LZ,L3"
1910 PRINT D$;"WRITE LZ,R1"
1920 PRINT A
1930 PRINT D$;"CLOSE LZ"
1940 RETURN
1950 REM READ DISK INFORMATION
NAME
1960 PRINT D$;"OPEN NAME$,L45"
1970 PRINT D$;"READ NAME$,R1"
1980 INPUT NAME$
1990 PRINT D$;"CLOSE NAME$"
2000 RETURN
2010 PRINT D$;"OPEN ISSUE$,L20"
2020 PRINT D$;"READ ISSUE$,R1"
2030 INPUT ISSUE$
2040 PRINT D$;"CLOSE ISSUE$"
2050 RETURN
2060 REM READ INFORMATION FROM
DISK
2070 PRINT D$;"OPEN SUBJECT$,L20
"
2080 PRINT D$;"READ SUBJECT$,R";
A
2090 INPUT SUBJECT$
2100 PRINT D$;"CLOSE SUBJECT$"
2110 PRINT D$;"OPEN TITLE$,L55"
2120 PRINT D$;"READ TITLE$,R";A
2130 INPUT TITLE$
2140 PRINT D$;"CLOSE TITLE$"
2150 PRINT D$;"OPEN AUTHOR$,L20"
2160 PRINT D$;"READ AUTHOR$,R";A
2170 INPUT AUTH$
2180 PRINT D$;"CLOSE AUTHOR$"
2190 RETURN
2200 REM DETERMINE TENSE
2210 IF X = 1 THEN C$(3) = "IS":
C$(4) = "LETTER": RETURN
2220 C$(3) = "ARE":C$(4) = "LETTE
RS": RETURN
2230 END
3000 A$(1) = " ":A$(2) = " ": RETURN

```

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```

REM  MERGE SORT USING LINK () FOR INDEX
FUNCTION  MERGE (I,J=INTEGER)=INTEGER
  VAR T,K,M=INTEGER
  IF ARRAY (I) < ARRAY (J) THEN
    BEGIN
      M=I
      I=J
      J=M
    END
  T=I
  KM=T
  I=LINK (I)
  WHILE I<>0 DO
    BEGIN
      IF ARRAY (I) < ARRAY (J) THEN
        BEGIN
          M=I
          I=J
          J=M
        END
      LINK(KM)=I
      KM=I
      I=LINK(I)
    END
  LINK(KM)=J
  END=T
FUNCTION  SORT (IS,J=INTEGER)=INTEGER
  VAR KS,II,JJ=INTEGER
  IF IS=JS THEN
    BEGIN
      LINK(IS)=0
      RETURNED.VALUE=IS
      GOTO  OEND
    END
  KS=IS+(JS-IS)/2
  II= SORT (IS,KS)
  JJ= SORT (KS+1,JS)
  RETURNED.VALUE=MERGE (II,JJ)
OEND
END=RETURNED.VALUE

```

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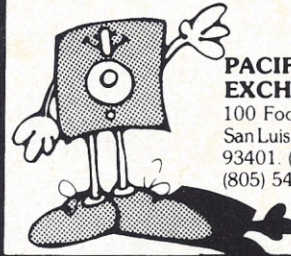
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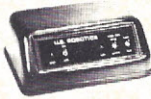
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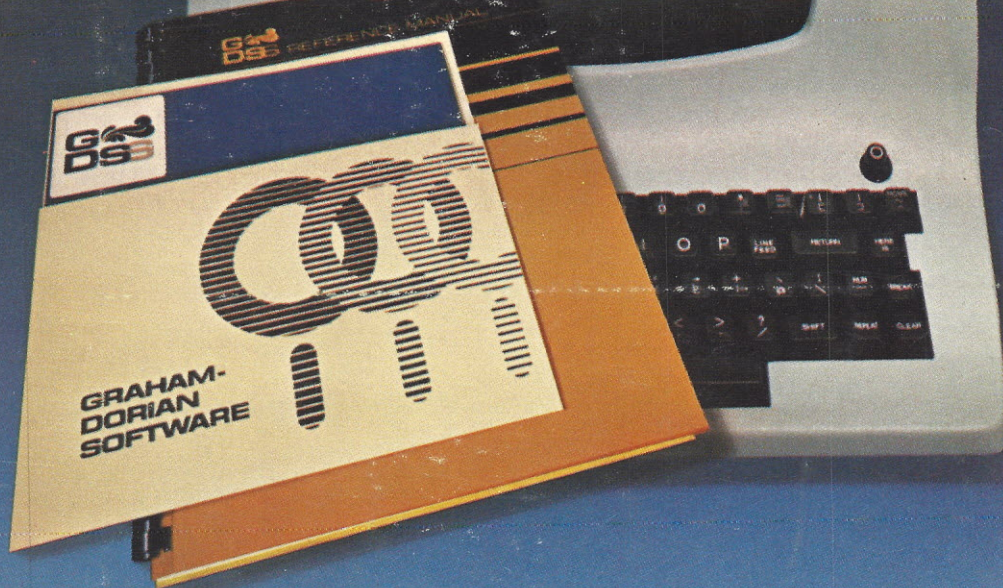
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